



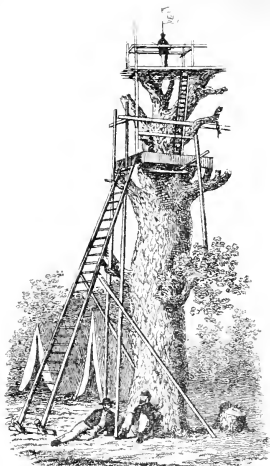
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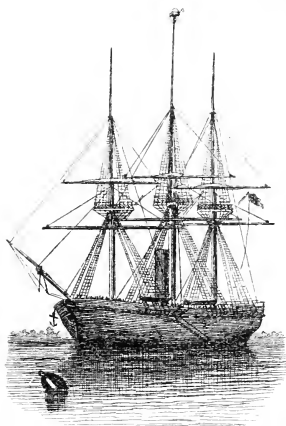




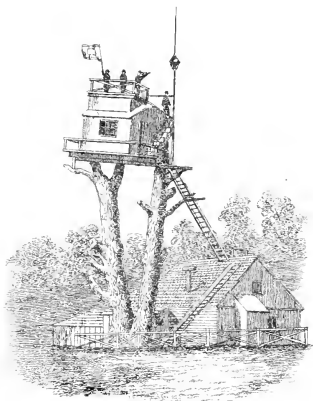




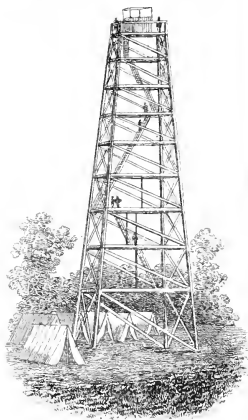
Tree Station on upper Potomac.



Signal Station at Masthead.  
U. S. Steamer Richmond.



Station in front of Washington. Operations against Richmond.  
130 ft high.



SIGNAL DEPT  
U.S.A.

A

# MANUAL OF SIGNALS:

FOR THE USE OF

SIGNAL OFFICERS IN THE FIELD,

AND FOR

MILITARY AND NAVAL STUDENTS, MILITARY  
SCHOOLS, ETC.

A NEW EDITION,  
ENLARGED AND ILLUSTRATED.

BY

BT. BRIG. GENL. ALBERT J. MYER,

CHIEF SIGNAL OFFICER OF THE ARMY, COLONEL OF THE SIGNAL CORPS  
DURING THE WAR OF THE REBELLION.

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1868.

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TO THE  
OFFICERS OF THE ARMY AND NAVY  
OF  
THE UNITED STATES,  
THIS WORK  
IS RESPECTFULLY INSCRIBED.

M510972





## P R E F A C E.

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THIS work was, for its first edition, in great part hastily prepared, printed upon an office press, and issued to the officers of the Signal Corps of the Army then serving constantly in the field in the midst of the war of the Rebellion. It was intended, at the time, for their instruction only, and was rendered incomplete by official embarrassments and the pressure of other duties. The author is induced to its enlargement and republication now by varied reasons. The actions of the late war, in which victory or defeat has sometimes hung upon the transmission of a signalled message, have rendered it certain that military signals will be used in the future military and naval operations of our arms. They will be employed in the continued Indian warfares in the Interior; and it is probable some knowledge of telegraphic duty will be required of the officers of both the land and naval services. The perfection to which these duties can be brought, by careful study, experiment, and practice, can be contemplated yet in imagination only. It has been aimed to furnish those to serve especially upon such duties, whether serving as in a corps or as detached, such plain and compendious instructions as

will enable them to do the duties well. It has been another object of the Author to provide a work of such a character that it may give to any who peruse it an idea of what it is possible to effect by signals, and how it is proposed to effect it; and, in fine, a conception of the services planned for a properly equipped Signal Corps, and the mode in which they are to be rendered. It is necessary for the successful use of such organizations, and for the right discharge of any signal duty, that those officers whose rank entitles them to frequent and large command should have a knowledge—such at least as they can gain by reading—of the service of which they may at any moment need to avail themselves. And it has been a natural wish on the part of the Author, that those with whom he has been associated may be convinced, by their own knowledge, that the plans for this branch of service have been carefully considered and are practicable.

Of the great, good results to be hoped from a popular and thorough knowledge of the subjects of the book, subjects hitherto so little treated, that the Author knows of no extended work relating to them, he can here make mention only. The character of the possible advantages must be judged after some perusal of the volume.

In preparing the work, the Author has availed himself of the information he has gained in some years of study, experiment, and active service. He has embodied in it whatever he has thought might be of value to the student.

In the revision and modification of plans which have come under his consideration, it has been difficult sometimes to credit exactly the labors of those who have treated of them; but if mention of any has been omitted, it has been through inadvertence. The Author claims for himself little originality or invention, other than would perhaps have come to any one who might have devoted an equal amount of time and labor to the subject.



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# MANUAL OF SIGNALS.

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SUCH limited attention has been paid to SIGNALS and TELEGRAPHY that, except among experts, there is little general information on the subject. The secrecy which is commonly preserved, and necessarily, in reference to the meanings of signals, made in the Land and Naval services, has led to an impression, that the subject involves something of mystery. There can be nothing easier of comprehension, than the principles upon which all signals are devised; or more simple, than the workings of the few rules which are applied to them.

A Sign or Signal is any thing, or sound, or act, or indication by which to excite attention or convey a meaning. A stroke of a clock-bell is a signal. Letters and characters are signals. To point the finger at any object is a signal.

Signals are of two kinds—*transient* and *permanent*. They are transient when each sign disappears as soon as it has been completed; as in signals by Motions or by Sounds. They are permanent when the signs are long in view; as when flags are kept hoisted to be read; or the symbols are written on paper; or a signal is made by placing a thing in a fixed position, and so retaining it—as the arm raised above the head.

The principle upon which all systems of signals are formed, is this: that, having a certain number of arbitrary, simple

signs, sounds, things, colors, or indications, each distinguishable from the other, these are made to appear joined together in any arrangements or combinations which are possible and expedient, to form other or different signals to any extent required. We wish, for example, to make a large number of signals—that is, a large number of signs or indications—which, when they are exhibited, in any way, to an observer, and recognized, shall each signify a certain meaning. We take any few different and simple known signs, sounds, motions, or indications, which we can easily make, and we join them together, twos or threes, or more at a time, making one after another, into many and different and more complex signs or arrangements. Each of these new signs becomes, when a meaning is given to it, a signal. We can increase the number of such signals to any limit, by continuing to join together the known signals in greater numbers, or in new arrangements. Any thing in existence, of which we take cognizance, or to which we can, through any sensation, direct the attention of others, can be used as a signal. For convenience of naming, the known signs or signals with which we commence, are called *single* or *primary* signals, or *elementary* signals. The new signs made by joining these elementary signs together, are called the *combinations* or *combination* signals. The elementary signs may be disposed, any number of them being used at a time, or any number of repetitions of any one of them, or repetitions of any one or more of them being joined, in very numerous and varied arrangements. The several signs exhibited together in one arrangement, then become one signal for any given meaning. This signal, thus made, is a signal by combination. It consists of several signals combined to make one.

The number of different sorts or kinds of signs or indications used, in making a combination signal, is called the number of elements of the signal. The number of signs, of

all kinds, actually used in one completed signal, is the number of elementary signals in that signal. A combination signal may be only an elementary signal repeated several times; or it may be repetitions of one elementary signal joined to others. In the signal "1131" there are two sorts of signals—viz., those indicated by the symbols "1," and those indicated by the symbols "3." The signal is thus of two elements. There are four signals taken together to make it. The number of elementary signals is four. In "1132" there are three elements and four primary signals. In "222" there are one element and three signals.

All *systematized* signals,—that is, signals formed under rules—and signals must be systematized, or formed under rules, if any great number of them are to be used,—are based on the principles above explained: that the elementary signals of any system being given, all signals of that system are made by combinations of those elementary signals. This principle is identical, in its operation, with that by which the separate letters—the elementary signals or symbols of language—form, by their combinations, the many single words of that language; or the numerical digits—the elementary signals or symbols of numbers—designate, by their arrangements, the infinity of numbers they are capable of expressing. In its application to telegraphic signals, this principle goes back to a further degree, and as in one word or expression of a number there are several characters, the elements which go to make up its unity, so in telegraphing each letter may often be designated by elementary signals, which, several in number, must join to indicate that single character.

#### OF RECORDING SIGNALS.

The *recording* of signals, is the writing them down. The notation of the characters standing for signals, is similar to that of any other characters in writing. Each elementary

signal is designated by any given character, number, or mark. The characters indicating the different elementary signals, joined in each combination signal, are written together, and by their kinds, number, and order of sequence, show the kinds, number, and sequences of the elementary signals which are used in that combination. Signals are thus written precisely as words are written. As in the written word are shown the letters—the elements of language which go to make up that word, their number, and the order in which they are spoken or exhibited to produce that word—so the record of a signal shows how many sorts or kinds of signs or indications are used to make the signal (the number of elements); how many single signs (elementary signals) are combined to make it; and the order in which each must be exhibited, when all are joined together in displaying the completed signal.

We take, for example, any three kinds of known signs, motions, or colors, which we propose to use as the elements on which to base a system of signals. We name these elements First, Second, and Third. We designate each elementary signal—that is, each of the three different signs, or each of the three different motions, or each of the three different colors—by figures, as 1 and 2 and 3; or by letters, as a and b and c; or by the letters w g r; or we designate them by any other three marks, or in any arbitrary manner.

If now we wish to show, writing the signals to be read by others, or observing and noting them down for our own reference, that the first and third motions are made together, one after the other, to make a signal; or, that the first and third colors are to be so shown as to indicate that one follows the other in a signal—that is, that in the given signal there are two elementary signs, and that the first is followed by the third—we write “13,” or “w g,” or “a c.” If using motions, the third motion is to be noted as made, and followed by the first motion, and that again by the third

motion, repeated, to make a signal; or, using colors, the color green is shown followed by the white, and that by the green again as a signal—that is, if the signal is to be the third elementary sign, followed by the first elementary sign, followed by the third elementary sign again repeated; or, more briefly, a third element followed by a first element, followed by a third element, we write “313,” or “c a c,” or “g w g.” If a “third motion” is made three times, in close succession, or three green colors are shown, one after the other, as the signal—that is, if the signal is a third element thrice repeated—we write “333,” or “g g g,” “c c c,” etc. If still using in no signal more than three different elements or kinds of elementary signals, a combination signal is made to consist of four elementary signals, as using three kinds of motions, four distinct motions are to be made together, one after the other, as a signal;—for instance, a “third motion” followed by a “second motion,” this followed by a “first motion,” and this by a “third motion” again, repeated; or, using three kinds of colors, four colors are shown together as a signal, as the green followed by the red, followed by the white, and this by green again—that is, the signal is a third element, followed by a second, followed by a first, followed by a third—it is written “3213,” or “g r w g,” or “c b a c.” If the signal is to be a first element shown three times in succession, it is written “111,” or “w w w,” or “a a a,” etc. If the signal is to be two first elements followed by two second elements, as two first motions and two second motions made together, or two white colors and two red colors shown together, it is written “1122,” or “a a b b,” or “w w r r.” At the end of the record of each completed signal, a period is marked upon the paper, or a space is left to separate it from the records of other signals, precisely as spaces are made between written words to distinguish each from the other.

The number of kinds of characters or symbols appearing

in the written record of a signal, shows how many sorts or kinds of signs or indications are used in making that signal—*i. e.*, the number of elements. This is called the elementary number of the signal. In the signal “1231,” there are three kinds of characters. The elementary number of this signal is “three.” It is a signal of three elements. In the signal “121,” there are two kinds of characters. The elementary number of the signal, is “two.” It is a signal of two elements. The elementary number of the signal “1211,” is “two.” The elementary number of the signal “2,” is “one.” The elementary number of the signal “111,” is “one.” The elementary number of the signal “11,” is “one.” The elementary number of the signal “13,” is “two.”

The number of characters in the written record of a signal, shows how many single or elementary signs or indications, of all kinds, are made combined to make that signal. This is called the combination number of the signal. To make the combination signal “1231,” four single signals are joined. The combination number of the signal is “four.” To make the signal “121,” three single signals are combined. The combination number of this signal is “three.” The combination number of the signal “111,” is “three.” Of the signal “121,” it is “three.” Of “13,” it is “two.”

Each elementary or single signal, appearing in a combination signal, and consequently each character, appearing in the written record of a signal, is numbered as and called *a place*. Thus, the signal “1231,” is a signal of four places. The signal “111,” is a signal of three places. The signal “132,” is a signal of three places. The signal “2,” is a signal of one place.

*A Class of signals* is all of those signals to make which the same number of signs must be used. All signals of the same number of places, are signals of the same class. Thus, the signals “121,” “b b c,” “333,” “w r g,” “123,” are all signals of three places. They are signals of the same class.



The signals "12," "31," "33," "11," are all signals of two places. They are of the same class.

Classes of signals are named from the number of places in each class. Thus, single signals, or signals of one place, as "2," "3," etc., are signals of the first class. Signals of two places, as "a a," "11," etc., are signals of the second class. Signals of three places, as "123," "111," "a a b," etc., are signals of the third class; and so on.

*A Code of signals* is any number of signals arranged and agreed upon, each having assigned to it its meaning. Codes of signals are named from the number of elements used in making those signals which appear in the code, or from the number of different kinds of symbols which appear in the record: as codes of two elements, of three elements; and so on.

### THE RULES OF PERMUTATIONS, COMBINATIONS, AND ARRANGEMENTS, AS APPLIED TO SIGNALS.

The mathematical rules for Permutations, Combinations, and Arrangements, by which any number of things, characters, signs, or symbols of any kind, being given, there are known the number and qualities of all the changes, combinations, and arrangements in which they can be placed together, apply equally, of course, to the changes, combinations, and arrangements which can be made with those characters, things, or signs, when used as signals; for, to make signals, is only to display the different elementaries given, in the different changes, combinations, and arrangements in which they can be put, giving to each display a separate meaning. The study of the applications of these rules to the formation of signals is interesting. The comprehension of the principles upon which signals are systematized under them makes clear the theories of signalling,

and enables us to trace the bases upon which all plans of signals must be formed.

---

*The Equation of Permutations* furnishes the formula by which any number of characters or things being given, there is known in how many different changes these characters or things can be arranged, having, in every arrangement, all the characters or things given, and no one of the characters or things to appear more than once in any arrangement. The Equation of Permutations is as follows :

Let  $N$  = number of changes to be sought.

$n$  = number of things or symbols.

Then  $N = 1 \times 2 \times 3 * * * * \times n = \text{answer}$ .

Or the number of changes which can be made, is equal to a series of numbers from one up to the given number (of things) multiplied continually together, the last product being the answer required.

APPLICATION.—Any certain number of things, signs, or indications, of which our senses can take cognizance, being taken as elementary signals or symbols, to find how many signals can be made, displaying all the elementary signals each time, and each time in a different arrangement, no elementary signal to appear more than once in any one arrangement—

RULE.—Designate all the elementary signals given, by numbers, each in a regular series, as 1, 2, 3, 4, 5, and so on, up to the given number. Multiply all of the series of numbers up to the given number continually together, and the last product will be the answer required.

If there are six things given, in how many changes can they be arranged, using all of the six in each change, and having six places in every change ?

Number of changes =  $1 \times 2 \times 3 \times 4 \times 5 \times 6 = 720$ .

If five things are given ?

Number of changes =  $1 \times 2 \times 3 \times 4 \times 5 = 120$ .

If three things are given ?

Number of changes =  $1 \times 2 \times 3 = 6$ .

For demonstration, let the three things be designated by a, b, c. We find, by trial, that we can arrange these three letters in six different ways, and no more; as thus: a b c, c b a, b c a, c a b, b a c, a c b.

Or, let three figures be used; as 1, 2, 3. We can arrange these figures as 1 2 3, 3 2 1, 2 3 1, 3 1 2, 2 1 3, 1 3 2, in six changes, and not otherwise.

Or, let the elements be three syllables, as mo-ta-la; they can be arranged as motala, lamota, tamola, talamo, molata, latoma: in six ways, and no more.

If two things are given, they can be arranged (number of changes =  $1 \times 2 = 2$ ) in two ways, and no other.

If four things have been given, the same rule shows there are twenty-four permutations of these things.

If five things are given, the permutations are one hundred and twenty; and so on.

If there are six different-colored flags (and only six) to be used as signals, we learn, by this rule, that we can make with these flags, hoisting all of them each time, and in a different order of arrangement for each signal, and never showing two similar flags in any signal, seven hundred and twenty signals. This is the limit of all the signals, so conditioned, that can be made with these flags.

Or, if there are six sounds or notes, as of a piano, there can be sounded, one after another, six notes at a time, for each signal, and in a different arrangement each time for each signal, seven hundred and twenty signals.

Or, if there are six distinct motions which can be made, one after the other there are seven hundred and twenty ways or sequences, in which these motions can be made, all

being made each time; they can represent seven hundred and twenty signals.

With five flags, or sounds, or motions, there would be, using no flag, sound, or motion twice in any signal, one hundred and twenty signals of five places.

With four flags, or sounds, or motions, there would be twenty-four signals of four places; and so on.

Thus, if the four flags are of different colors, as a white, a red, a green, a blue, they can be hoisted, four at a time, twenty-four different ways, reading from above down, thus: 1st, white, red, green, blue; 2d, red, white, green, blue; 3d, green, white, red, blue; and so for twenty-four changes.

Or, if there are four sounds, a long, a short, a high, and a low, they can be sounded, all four at a time, in twenty-four different orders, as thus: 1st, long, short, high, low; 2d, short, long, high, low; 3d, high, long, short, low; and so for twenty-four changes.

Or, if there are four motions, as with the hand, starting from a given point, say as high as, and in front of the shoulder, a motion up, a motion down, a motion to the right, a motion to the left, they can be made, making all four motions at a time, twenty-four different ways, as thus: 1st, up, down, right, left; 2d, down, up, right, left; 3d, right, down, up, left; and so on for twenty-four changes.

This rule applies, the number of elements being greater or less, as the case may be, through all the myriad modes in which we may devise the elementary signals.

*The Table of Permutations*, computed up to those which can be made with nine elements, is as follows:

THE NUMBER OF THINGS OR SYMBOLS BEING—	THE NUMBER OF CHANGES WHICH CAN BE MADE WITH THESE THINGS OR SYMBOLS IS—
1	1
2	2
3	6
4	24
5	120
6	720
7	5040
8	40320
9	362880

This table is sometimes of value for immediate reference. It is frequently necessary to agree that each preconcerted signal shall consist of a certain number of symbols, and also of a certain number of places: as that each signal shall contain five different elements, and be of five places. In such cases, if we have five signals or sounds, or flags, or characters, we know that we may exhibit them, five at a time, and in one hundred and twenty different ways. We can form a code accordingly.

Or, if nine things are given us, that they may be shown, nine at a time, and in three hundred and sixty-two thousand eight hundred and eighty changes. We can make with them this number of distinct signals.

---

*The Equation of Combinations* is the formula by which, any number of different things being given, there is found how many changes can be made with these things, taking any given number of them at a time.

APPLICATION.—Any number of elementary signals, or symbols standing for them, being given, to find how many combination signals can be made, using the elementary

signals in given numbers of them at a time, and no elementary signal appearing more than once in any signal—

**RULE.**—Designate the elementary signals or things by numbers, in regular series, up to the full number given. Take a regular series of decreasing numbers, beginning with a number equal to the full number of elementary signals (symbols) given, and diminishing by one for as many terms as shall be equal to the number of elementary signals to be used at a time, multiply the numbers of this series together, and the product will be the amount required.

**ILLUSTRATION.**—If five things are given, how many different combinations can be made, using all of these things, but using only three at a time?

The number of combinations  $= 5 \times 4 \times 3 = 60$ , the answer.

If three things are given, how many combinations can be made, using only two things at a time?

Number of combinations  $= 3 \times 2 = 6$ , the answer.

For illustration, let the three things given be the letters a, b, c. The combination of these letters by twos are ab, ac, bc, ba, cb, ca, or six in number. Or let the three things be three figures, 1, 2, 3. The combination of these figures, by twos, are 12, 13, 21, 23, 31, 32, six in number. Or let the three things be three syllables, mo-ta-la. The combination of these syllables, by twos, are mo-la, mo-ta, la-ta, la-ma, ta-mo, ta-la, or six in number.

If seven things are given, to be used three at a time, no thing being used more than once in any combination, the number of combinations would be  $7 \times 6 \times 5 = 210$ , the answer.

If there are six different-colored flags to be used as signals, we learn, by this rule, that there can be made with these flags, hoisting them two at a time and in a different order of arrangement for each signal, and never showing two similar flags in any signal ( $6 \times 5 = 30$ ), thirty signals.

Or hoisting three flags at a time, with the same conditions ( $6 \times 5 \times 4 = 120$ ), one hundred and twenty signals.

Or hoisting four flags at a time ( $6 \times 5 \times 4 \times 3 = 360$ ), three hundred and sixty signals.

Or hoisting five flags at a time ( $6 \times 5 \times 4 \times 3 \times 2 = 720$ ), seven hundred and twenty signals.

Or hoisting six flags at a time ( $6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$ ), seven hundred and twenty signals.

The practical use of this rule, is to enable us to at once determine, any number of things, motions, etc., being decided upon to be used as signals, how many signals can be made with them, using them by twos or threes, or other number of them together.

If then there are six sounds or notes, as of a piano, there can be sounded two dissimilar notes, one after the other at a time, for each signal, and in different order of arrangement for each signal, thirty signals. Or, with three notes at a time, there can be sounded one hundred and twenty signals. Or, with four notes sounded, four hundred and eighty signals. Or, with five notes at a time sounded, two thousand four hundred signals.

If there are eight kinds of flashes, how many different signals can be made, showing two dissimilar flashes at a time? ( $8 \times 7 = 56$ ), the answer.

How many different signals can be arranged for six different kinds of rockets, it being agreed that three dissimilar rockets shall be thrown up for each signal? Answer, 120.

If there are nine different-colored flags, how many signals can be made, hoisting four different flags at a time? Answer,  $9 \times 8 \times 7 \times 6 = 3024$ .

With five different sounds, how many signals of the third class, or of three places, can be made? Answer,  $5 \times 4 \times 3 = 60$ . How many signals of the 2d class? Answer,  $5 \times 4 = 20$ .

Any number of things being given, to ascertain the sum of all the modes in which they can be exhibited, using all, or any one, or any number of them, at a time, no thing appearing twice in any exhibition.

**RULE.**—Find the number of combinations of each class which can be made with the things given. The sum of these numbers added together will be the answer required.

**APPLICATION.**—Any certain elementary or primary signals being given, to find how many signals in all can be displayed, computing all the signals which can be exhibited with these elementary signals, using all of them or any numbers of them together, or any one of them, no elementary signal appearing more than once in any signal—

Find, by the preceding rules, the number of signals of each class which can be made with the given number of signals. The sum of all these numbers, added together, will be the answer required.

If there are six elementary signals given, the total of all the signals which can be exhibited will be: 1st, all the signals which can be shown by using the given signals separately, each as a single signal: or signals of one place, or of the 1st class. Added to [2d] all the signals which can be made by using the given signals by twos, or as signals of two places, or 2d class. Added to [3d] those which can be made by using them by threes—that is, signals of three places, or 3d class. Added to [4th] those which can be made by using them by fours—that is, signals of four places, or 4th class. Added to [5th] those which can be made by using them by fives—that is, signals of five places, or 5th class. Added to [6th] those which can be made by using them by sixes—that is, signals of six places, or the 6th class. Thus, by preceding rules, the total number of signals



equals 6 [signals of the 1st class] + 30 [signals 2d class] + 120 [signals 3d class] + 360 [signals 4th class] + 720 [signals 5th class] 720 [signals 6th class] equals 1956, the answer.

If five elementary signals are given, how many signals, of all kinds, can be exhibited?  $\text{Number} = (5 + (4 \times 5) = 20 + (5 \times 4 \times 3) = 60 + (5 \times 4 \times 3 \times 2) = 120 + (5 \times 4 \times 3 \times 2) = 120) = 325$ , the answer.

If there are six different flags, how many signals can be made showing no two similar flags in any signal?

There can be made, showing one flag at a time, six signals; showing two at a time, thirty signals; showing three at a time, one hundred and twenty signals; showing four at a time, three hundred and sixty signals; showing five at a time, seven hundred and twenty signals; showing six at a time, seven hundred and twenty signals. The total is 1956 signals.

If there are four different sounds or notes, as of an instrument, how many signals, of all kinds, can be made, sounding no two similar notes in any signal?

There can be sounded four signals of one note each, twelve signals of two notes, twenty-four signals of three notes, twenty-four signals of four notes. Total, 64 signals.

If there are four different motions, how many signals can be made, making no two motions alike in any signal?

There can be four signals of one motion each, twelve signals of two motions each, twenty-four signals of three motions each, twenty-four signals of four motions each: equal to sixty-four signals in all.

The practical use of these rules is to enable us to determine, any certain number of signs, sounds, motions, etc., being decided upon to be used as signals, how many dif-

ferent signals, of all kinds, we can display with them, using no sign twice in any signal.

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*Equations of Arrangements.*—Any certain number of sorts of elementary signals, or symbols standing for them, being given, and it being permitted to use any combination or arrangement of these signals, or of the symbols, and any repetition of any one or more of them in any signal, to find how many signals of any class—that is, of any certain number of places, can be made with these signals—

**RULE.**—Take the whole number of elementary signals, or of the symbols, and multiply it continually by itself so many times less one as there are places in the required signal; or raise the given number of signals or of symbols to that power of which the number of places to be in the required signals shall be the exponent.

The formula is as follows :

Let  $N$  = the number of changes of possible signals.

$n$  = number of sorts of things (of the elementary signals or of symbols).

$n'$  = number of places to be in the required signals.

Then  $N = n^{n'}$ .

**EXAMPLE.**—Using three sorts of elementary signals, and repeating any symbol as often as may be necessary in any combination signal, how many signals of four places (4th class) may be made ?

Number of 4th class signals =  $3 \times 3 \times 3 \times 3$  or  $3^4 = 81$ .

How many signals of three places ?

Number  $3^3$ , or  $3 \times 3 \times 3 = 27$  signals.

For demonstration, let the given signals, or things, be of the sorts designated, as 1, 2, 3. These figures can be arranged, 111, 222, 333, 112, 113, 221, 223, 331, 332, 213, 312, 321, 123, 132, 231, 232, 212, 323, 313, 121, 131, 133,

122, 233, 211, 322, 311—that is, in twenty-seven modes. No other or more exhibitions of three places are possible.

Or let the sorts of things be of letters, as a, b, c. Letters of these kinds can be exhibited in expressions of three places, as follows, and not otherwise: aaa, bbb, ccc, aab, aac, bba, bbc—and thus on to twenty-seven expressions.

It will be seen, in these two instances, that the result attained, by actual trial, is precisely that indicated by the mathematical rule.

Having two sorts of flags, as a number of red flags and a number of white flags; or a number of strips of red cloth and of white cloth, how many signals can be exhibited, showing four flags or strips in each signal?  $2 \times 2 \times 2 \times 2$ , or  $2^4 = 16$ , the answer.

How many showing three flags at a time?  $2 \times 2 \times 2 = 8$ , the answer.

With any two sorts of sounds, as of a bass and of a light drum; or, two different kinds of notes, as of a piano or a bugle, how many signals can be sounded with three sounds in each signal? Number  $= 2 \times 2 \times 2 = 8$ , the answer.

With any two sorts of motions, as motions to the right and motions to the left, or motions up and motions down, how many signals can be made, making four motions for each signal? Number  $= 2^4 = 16$ , the answer.

Any certain number of sorts of elementary signals, or symbols standing for them, being given, to find how many different signals can be made, computing all the signals which can be exhibited with these elementary signals, using all the expressions which can be made by exhibiting any numbers of them together, or any one of them, or any repetitions of any one or more of them in any signal, the limit of computation being fixed only by the number of places to be in the highest class of signals—

**RULE.**—Find the number of signals of each class which can be made with the given elementary signals up to and

including those of the limiting class; add these numbers together. The sum will be the answer.

The formula is as follows:

Let  $N$  = number of signals required.

$n$  = number of sorts of things or signals (of the elements or of the symbols).

$n'$  = number of places to be in the limiting class of signals.

Then  $N = n + n^2 + n^3 + * * * * + n^{n'}$  equal the answer.

EXAMPLE.—If there are three sorts of elementary signals, how many signals, of all kinds, can be made, computing up to those of four places?

Number = 3 (signals of 1st class, or single signals) + 9 (signals of 2d class, or of two places) + 27 (signals of 3d class, or of three places) + 81 (signals of 4th class, or of four places) = 120, the answer.

Or, more plainly, the total number of possible signals, with these conditions, is the number of signals of one place that can be made added to the signals of two places, added to the signals of three places, added to the signals of four places, the limit.

If there are two sorts of elementary signals—that is, if the elements to be used in making any required signals are but two in number—how many signals can be made, no signal having more than three places?

Number = 2 (signals of the first class) + 4 (signals of 2d class) + 8 (signals of the 3d class) = 14, the answer.

If there are six kinds of motions, how many signals can be made, having in no signal more than three motions?—Six of one motion, thirty-six of two motions, two hundred and sixteen of three motions. Total, 258 signals, the answer.

How many different signals can be made with drums, hats, knapsacks, and coats, showing not more than four articles for any signal?

Number  $= 4 + 4^2 + 4^3 + 4^4 = 340$ , the answer.

If there are two sorts of flashes, as of red flashes and of white flashes, how many signals can be made, no signal having more than five flashes?

Number  $= 2 + 2^2 + 2^3 + 2^4 + 2^5$ ; or,  $2 + 4 + 8 + 16 + 32 = 62$ , the answer.

If there are two kinds of motions, as motions up and motions down, from a fixed point, how many signals can be made, using not more than four motions for any signal?

Answer, 30.

For convenience of reference is inserted the table on the following page, showing the number of sorts of elementary signals (*i. e.*, the elements) to be used, and the number of places to appear in the signal being given, how many signals of each class (that is, of any certain number of places) can be made. This table is drawn for all signals up to those of nine elements and nine places.

For use, find at the left of the table, between two horizontal lines, the number of elements. Find at the top of the table, between vertical lines, the number of class, or number of places to be in the signals. The number inclosed by these four lines, at their intersection, shows the number of signals that can be made. Thus, with three elements, how many signals of four places can be made? Find three (the number of elements) on the left of the table. Find four (the number of places) at the top. The number at the intersection of the inclosing lines is 81, the answer.

With seven elements, how many signals of the 4th class can be made? Number opposite 7, on the left of the table, and 4, at the top, is 2401.

*Table of Reference for all Signals from One to Nine Elements, and from One to Nine Places.*

1	2	3	4	5	6	7	8	9
2	4	8	16	32	64	128	256	512
3	9	27	81	243	729	2187	6561	19683
4	16	64	256	1024	4096	16384	65536	262344
5	25	125	625	3125	15625	78125	390625	1953125
6	36	216	1296	7776	46656	279936	1679616	10077696
7	49	343	2401	16807	117649	823543	5764801	40353607
8	64	512	4096	32768	262144	2097152	16777216	134217728
9	81	729	6561	59049	531441	4782969	43046721	387420489



# PLATE I.

## EXAMPLES OF PERMUTATIONS, COMBINATIONS, AND ARRANGEMENTS.

There being given as Symbols—Red, Green, Yellow, Blue, Purple.

### THESE ARE PERMUTATIONS.



In Permutations, all the Symbols given are used, but each time differently placed.

---

Symbols given : Red, Green, Yellow, Blue, Purple.

### THESE ARE COMBINATIONS.



In Combinations, the Symbols given are used two or three or more together at a time.

No Symbol is used more than once in any Combination.

---

Symbols given : Red, Green, Yellow, Blue, Purple.

### THESE ARE ARRANGEMENTS.



In Arrangements, all the Symbols may be used in any arrangement, or they may be used two or three or more together to any extent, and any of the Symbols may be repeated any number of times in any arrangement.



Plate I. affords Examples of Permutations, Combinations, and Arrangements. These can be practically illustrated by the use of colored blocks to be permuted, combined, or arranged at will.

The Rules of Permutations and Combinations best apply to permanent signals. As signals of this kind are generally shown, all the elementary signals, or the components of the complete signal, are exhibited together, and remain in view so long as the signal is exposed. It is thus difficult, is inconvenient, and is often impossible to repeat any of them in the same signal. Similarly, the Permutations and Combinations of any determined number of things show only those changes which can be made without repeating anything in any change.

The Rules for Arrangements have their most useful applications to transient signals; or, to those cases in which it is necessary to improvise signals with any things that may be at hand; as when there are but very few kinds of articles, but large numbers of similar articles of each kind, as strips of flannel of two or three different colors; coats and kerchiefs; caps and knapsacks; drums and bunches of hay, etc.

Transient signals, and signals made with these simple things or signs, admit readily of repetitions. It is easy in making signals of flashes, as by a lantern, to repeat these flashes, making one after the other; and similarly can be repeated sounds, as of a bell, or motions made with anything. In the same way, if there are strips of flannel, and there are only two colors among them, it is easy to hoist the strips two, or three, or four at a time: the repetitions of any strip in any signal forming parts of that signal. Some idea of the very great gain in the scope of representation, which is made by using in signals all the arrangements into which repetitions or combinations of repetitions enter, may be had from the following instance:

With three things used as signals, in all ways, as by ones, by twos, and by threes, we can make but fifteen signals, if no repetition is permitted in any signal. Thus there are [see combinations] 3 of one place, + 6 of two places, + 6 of three places, = 15.

With three sorts of things, repetitions of things being used as signals, and repetitions of one or more of them being permitted in any signal, we can make, no signal having more than three places, thirty-nine signals. Thus, there are [see arrangements] 3 of one place, + 9 of two places, + 27 of three places, = 39. Or the power of representation is more than doubled.


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#### ALPHABETIC ELEMENTARY CODES.


The Alphabet we use is a code of twenty-six signals, by combinations of which all words [word-signals] are made, and which, by long practice, we recognize readily when made by sound [spoken], or by sight [written]. All language [spoken or written] is simply signals by sound; or, signals made visible. Any other signal symbols would have answered just as well for the letters, if we were as well trained to recognize them. To illustrate this, it is necessary only to consider the different alphabets of the different languages, which, differing from each other in appearance and in sound, are equally efficient to convey all meanings of the respective languages. To devise telegraphic alphabets, or sign-languages for the English language, is to represent these twenty-six letter-signals by other signals. These other signals we make as simply as possible. We may designate each letter by a distinct or arbitrary signal. It is better to use systematized signals. Thus, if we have any two motions, signs, sounds, etc., we are to use as ele-

ments or symbols, we designate the twenty-six letters of the alphabet, each by one of the first twenty-six arrangements, or combinations of these elements. Or, we may use any twenty-six combinations or arrangements. The first twenty-six are generally used, because they are the shortest.

Thus, for instance, there are, say, two elements, and these are symbolized by the figures "1" and "2." Then A may be 1, B may be 2, C may be 12, D may be 22, E may be 11, F may be 21, G may be 121, H may be 212, I may be 221, J may be 112; and so on. Now, for a second illustration, if the primaries taken are colors, as red and white, then "1" may stand for the "red," and "2" for the "white;" and the letters may be the colors shown. Thus,

A, may be 12, which is "red-white;" or, 

B, " 121, " "red-white-red," " 








C, " 111, " "red-red-red," " 

and thus for all the alphabet.

It is as easy to read "A," or "B," or "C," when we see these color-symbols, as it is to read A or B or C printed. This is a code of two elements.

Now if, instead of two motions, or two colors, etc., or two elements, there are to be three, then we designate the twenty-six letters of the alphabet, each by one of the first twenty-six combinations or arrangements of three symbols. Then, for instance, A may be 1, B may be 2, C may be 3, D may be 12, E may be 13, F may be 21, G 31; and thus on.

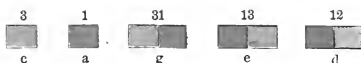
Now if the three primaries are colors, as red, green, and yellow, then—

A,	may be 1,	which is "red,"	or,	
B,	" 2,	" "green,"	"	
C,	" 3,	" "yellow,"	"	
D,	" 12,	" "red-green,"	"	
E,	" 13,	" "red-yellow,"	"	
F,	" 21,	" "green-red,"	"	
G,	" 31,	" "yellow-red,"	"	

and thus on.

The letters now under a different guise from those last shown, are as easily read in the colors as before, or as the printed letters.

So they as easily form words; thus the word CAGED is in color-symbols:



The word BEADED is in color-symbols:










The same word is in figure-symbols:

2      13      1      12      13      12

If there are five elements assumed, the symbols are 1, 2, 3, 4, 5. Then A may be 12, B 13, C 14, D 15, E 21, F 22, G 23, and so on.

Now if the elements are colors, as red, green, yellow, blue, and black, then—

A,	may be 12,	which is "red-green,"	
B,	" 13,	" "red-yellow,"	







C,	may be 14,	which is "red-blue,"	
D,	" 15,	" "red-black,"	
E,	" 21,	" "green-red,"	
F,	" 22,	" "green-green,"	
G,	" 23,	" "green-yellow,"	

and thus on.

The color-letters are again as legible as the printed.

If there are six elements, then the signal alphabet is the first twenty-six arrangements of these elements. Symbolized, A may be 22; B may be 13; C may be 14; D may be 15; E may be 16; F may be 21; and so on.

If these elements are colors, as red, green, yellow, blue, white, and black—

Then A is,	
B "	
C "	
D "	
E "	
F "	

and so for the alphabet.

It will be noticed by these illustrations, that the number-symbol standing for each letter, as clearly symbolizes it as does the color-symbol. The letter-numbers, written each after another in proper sequence, form words.


In the same manner, if the elements had been, instead of the colors, different motions or sounds, etc., symbolized by the figures 1, 2, 3, 4, 5, 6, etc., as have been the colors in


these examples, the figure combination or number standing for each letter, would clearly indicate the signal motions or sounds, etc., required to be made together to signify it.


It is rarely worth the while to devise signal alphabets of more than six elements for the purpose of telegraphing. The principle of procedure would remain the same.

Signal *Numerals* are devised after the same manner as the Letters, by the arrangements of the given elements; ten additional arrangements, made for this purpose upon the same plans as the letter-signals, designating the nine digits and the cipher. Thus, to make an alphabet, and in addition the numeral digits, the first thirty-six, or any thirty-six arrangements of the given elements are taken. The illustrations for the numerals in the codes of each order (*i. e.*, those of two, three, four, five, and six elements, and so on) would be similar to those in the cases of the letters of the Alphabets.

Thus, for a code of two elements, the colors "white" and "red" being elements, and the figures "1" and "2" the symbols—


The numeral character "1" may be symbolized as 1221, or, "white-red-red-white;" or, 


The numeral character "2" may be 2112, or, "red-white-white-red;" or, 


The numeral character "3" may be 2212, or, "red-red-white-red;" or, 

and so continued for all the digits and the cipher.

For a code of three elements, colors "red," "white," and "blue," the elements; figures "1," "2," "3," the symbols,

the numeral character "1" may be 321, or, "blue-white-red ; or, 

The numeral character "2" may be 123, or, "red-white-blue;" or, 

The numeral character "3" may be 132, or, "red-blue-white;" or, 


etc., etc., etc.


When distinctive signals are not devised for the numerals, the letters of the alphabet are sometimes used as numerals. Thus, A would stand for the numeral "1;" B stands for the numeral "2;" C stands for the numeral "3;" and so for the ten characters. Thus to make "365," there would be written or signalled "C F E." To make "10," is made "AJ." To make "12," is made "AB." To make "42," is made "DB."


The Roman style of numeral letters may be used when they are preferable.

Periods, Commas, points of punctuation, etc., are, in each order of signals, formed by arrangements of the same elements as are the alphabets.

Thus for a code of two elements, "red" and "white:"

A period "." may be 12221, or, 

A comma "," " 21112, " 

A colon ":" " 21212, " 

The illustrations for codes of three or four or more elements may be devised.

It will be understood that any motions, colors, or signs could have been used as elements instead of the colors above given for illustration.

To complete a sign-language, it is only necessary that letter-signals, formed as here illustrated, should be made one after the other into words, having a pause of time or a signal after each letter, so that each may be distinct; and a longer pause, or a pause-signal, after each word, to show that it is completed. As a general rule, the pause of time will be sufficient to separate the letters. It is proper to use a pause-signal after each word. Signal numerals and points of punctuation, etc., should be used when they are necessary, the completed numeral, or point of punctuation, having after it a pause-signal.

Preceding and following numeral letters, should be a preconcerted signal: the signal letter "n," for instance, to clearly note the letters to be used as numerals.

#### MESSAGE CODES OF SIGNALS.

Message codes are devised that messages may be sent by preconcert. When parties are about to separate, it may be necessary to provide for such communication, or it may be needed in certain contingencies possibly foreseen. Codes are prepared as follows:

Any number of signals, or any number of numerals, or any number of letters are written in a column, one after the other, either singly or combined. Opposite each of them, or any of them, are placed whole sentences, or parts of sentences, which it may be supposed it will be necessary to transmit. For each of these sentences, the appropriate numerals, or letters, stand—that is, they indicate it. Now, when any one or more of these number or letter indices are signalled, the sentence opposite in the column, and for which it or they stand, is supposed to be meant, or transmitted; and these sentences are read, either one at a time, conveying complete messages; or one after the other, in the order



in which the indices are shown, making together the complete message.

#### EXAMPLES OF CODES.

- 1, Close with the enemy.
- 2, Enemy are pressing.
- 3, Close to the works.
- 4, Send us.
- 5, Men.
- 6, Horses and harness.
- 7, Guns and ammunition.
- 8, I will go.
- 9, Fall back to your first position.
- 10, Enemy are in full retreat.
- 11, Cease firing.
- 23, Advance cautiously, etc., etc.

Such lists may be prolonged indefinitely.

Or, this could be written as follows; the first ten letters of the alphabet used instead of the numeral characters:

- A, Close with the enemy.
- B, Enemy are pressing.
- C, Close to the works.
- D, Send us.

\* \* \* \*

AA, Cease firing.

BC, Advance cautiously, etc., etc.

And so through the list.

Now the indices in the columns may be of any number of places, and their number may be increased to any extent. So, for instance:

89, or HI, which may stand for, "we are in want of siege materials;"

90, or IJ, which may stand for, "the obstacles are impassable;"

989, or IHI, which may stand for, "we will rejoin you to-morrow;"

9901, or IIJA, which may stand for, "be guided hereafter by written instructions;"

are examples of indices in two, three, and four places. So thousands of messages may be written in books, each message having opposite to it its indicating numbers or letters. The signal-books of navies are arranged in this manner.

If with such lists the numeral "1" or "A" is signalled, the signal would be read, "Close with the enemy."

The signal "2" or the letter "B" made or shown is read, "Enemy are pressing."

So any sentence is indicated by signalling the figures or letters which stand for it. These figures or letters must be signalled without any pause-signals or separating signals between them, when the clauses or sentences are to be read conjoined. Meanings are entirely changed by using or not using separating signals between the figures. For example, the signal "23" or "BC" shown is read, "Advance cautiously." But the signals "2" and "3," or the letters "B" and "C," made or shown in close succession, with a distinct separating signal between them, are read, "Enemy are pressing—Close to the works." The numeral "4" or letter "D" made alone is read, "Send us." The numeral "3" or letter "C" signalled is read, "Close to the works." The signal "4—3" or "D—C" (that is, these signals made with separating signal between them), is read, "Send us—Close to the works;" the sentences being joined together in the order in which the signals are exhibited. The signal "43" or "DC," the same signals without the separating signal, might have an entirely different meaning, and might stand for any single sentence.

In the supposed list, the signal "4673," or "DFGC," signalled together, might mean, "Open communication with

the Fleet from both sides of the river," or any preconcerted message. The signals "4—6—7—3," or "D—F—G—C," signalled one after the other and separated, would read, "Send us—horses and harness—guns and ammunition—close to the works."

Codes can be made to contain any number of messages, and of greater or less length. It is often convenient to have codes arranged for a very few sentences: as for detachments operating in a mountainous country a few messages may be arranged which will enable them to combine their movements at distances of twenty or thirty miles.

It is not essential, in forming codes, that the indices shall be formed with the combinations of the nine digits and the cipher. Any given number of symbols or letters, or any simple signals, may be taken, and then every possible arrangement of these becomes, when exhibited, an indicating signal for a sentence. The rules before given enable us to compute, before attempting to draw the codes, how many indicating signals can be thus made; how many signals each of a certain number of places can be made; and other facts necessary to be known. These points will be understood by reference to the examples under the rules.

To form codes, is only to attach meanings to any signals. The signals themselves are to be studied and computed under the rules which have been given. Thus, if but three elements are to be used, codes would be drawn containing only the arrangements of three symbols: as, for instance, those of the characters "1," "2," and "3;" and there could be so many signals in the code as there are arrangements of three symbols, counting all up to arrangements of any fixed number of places.

1 may be, "Cavalry are approaching rapidly on your right and rear."

2 " " "The shells are thrown too far and have too long fuses."

3	may be	"Keep that range; shots striking well."
13	"	"The shots are killing our own men."
112	"	"Anchor further in shore."
111	"	"Shell between 4th and 5th traverses."
213	"	"We have carried the 4th traverse."
3321	"	"Send sailors to left and rear."
32212	"	"Withdraw the marines; the sea wall is too high."
2321	"	"Bring up a battery of howitzers."
3333	"	"Fire rapidly by compass S. S. W."
22	"	"We have carried the works; cease firing."

It is evident that any number of these, or of other messages, may be indicated by showing not more than three sorts of flags or signals in different arrangements. The extent to which representations can, in this way, be carried, may be estimated from the fact, that with six sorts of flags, or lights, or motions, there can be made, showing in no signal more than six symbols, fifty-five thousand, nine hundred and eighty-six signals. Thus there can be six signals made, showing a single light for each; thirty-six signals, showing two lights for each; two hundred and sixteen signals, showing three lights for each, one thousand, two hundred and ninety-six signals, showing four lights for each; seven thousand, seven hundred and seventy-six signals, showing five lights for each; forty-six thousand, six hundred and fifty-six signals, showing six lights for each.

In drawing a code for all these signals, it is plain no more than six distinct letters, or six distinct figures (six different symbols), one to stand for each light, need be used.

It is a general principle, in forming codes of signals, that the indices should be as brief as possible; thus the number of elements to be used being given, it should be determined

by computation beforehand, how many, and what are the shortest combinations that can be used ; and to these should be attached the meanings which are to form the code. Thus, if there are five elements to be used, we can designate these by numerals, 1, 2, 3, 4, 5, or by the letters *a, b, c, d, e*.

Now we know by the rules of permutations, combinations, or arrangements how many indices of two, three, or more places we can form with these figures or letters. We write down, of the shortest of these, as many as we may need ; these are our indices. We place opposite each index whatever sentence we may wish to indicate by it, and so a code is formed. It is of course immaterial whether each letter or figure is indicated, when we come to signalize these indices by a flag, a colored flame, a sign, a motion, flash, sound, or even by measured intervals of silence—the meanings will be equally conveyed.

---

### EXAMPLE OF A NAVAL CODE.

55	Will be at single anchor	69	Stream anchor-s
56	Are you going to anchor ?	70	Kedge anchor-s
57	Shall endeavor to anchor	71	Prepare to anchor
	in the bay, in view, or	72	Anchor immediately
	the one pointed out	73	Anchor as soon as convenient
58	Propose-s to anchor, if the	74	Anchor on bearing pointed out
	wind will allow of getting	75	Anchor in line of battle
	into a tolerable	76	Anchor in order of sailing
	berth, and the bottom is	77	Anchor in line abreast
	satisfactory	78	Anchor in two columns
59	Can you spare an anchor ?	79	Anchor in three columns
60	Only one anchor left	80	Anchor as most convenient to fire at a mark
61	When you, he, or they are	81	Anchor in two lines, boats
	anchored		with guns in advance,
62	Lost an anchor		and in close order
63	No anchor left	82	Anchor close in shore
64	In want of an anchor	83	Anchor in close order
65	Have crept for my anchor	84	Anchor in open order
66	Anchor stock-s		
67	Sheet anchor-s		
68	Bower anchor-s		

- |     |   |     |   |
|-----|---|-----|---|
| 85  | I shall anchor                                  | 122 | Attack has commenced  |
| 86  | Shall I anchor?                                 | 123 | Baggage   |
| 87  | Creep for anchor                                | 124 | Send baggage to the rear  |
| 88  | Weigh anchor                                    | 125 | Pack up baggage ready to retreat  |
| 89  | Anchorage is safe, or good anchorage for ships  | 126 | Leave heavy baggage on board  |
| 90  | Anchorage is unsafe                             | 127 | Barge-s   |
| 91  | Cut out, and bring off vessels at the anchorage | 128 | Send the barge  |
| 92  | Destroy vessels at the anchorage                |     | <i>Note.</i> —Numeral signal will show which  |
| 93  | Arsenal-s                                       | 129 | Recall the barge  |
| 94  | Destroy the arsenal                             | 130 | Battery-ies   |
| 95  | Assist-s-ed-ing-ance-t-s                        | 131 | Are there any batteries?  |
| 96  | Can you assist?                                 | 132 | What state do the batteries appear to be in?  |
| 97  | Can you assist me with?                         | 133 | There are batteries   |
| 98  | Have, or has, given every assistance            | 134 | There are no batteries  |
| 99  | If I have immediate assistance                  | 135 | The battery-ies can be  |
| 100 | Do not, or did not, require any assistance      | 136 | Under the battery-ies   |
| 101 | Require-s the assistance of                     | 137 | Keep possession of the battery-ies  |
| 102 | Require-s immediate assistance                  | 138 | The enemy's batteries are destroyed   |
| 103 | Do you require assistance?                      | 139 | Can you keep possession of the battery-ies?   |
| 104 | Will you give any assistance?                   | 140 | The enemy is throwing up batteries  |
| 105 | Cannot assist                                   | 141 | Bayonet-s   |
| 106 | Should you require any assistance               | 142 | Charge bayonets   |
| 107 | What assistance do you require?                 | 143 | I am in need of bayonets  |
| 108 | Give every assistance to                        | 144 | I can spare bayonets  |
| 109 | Give immediate assistance to                    | 145 | I have no bayonets  |
| 110 | With the assistance of                          | 146 | Send me bayonets  |
| 111 | Without any assistance                          | 147 | Beam-s  |
| 112 | Assist disabled vessels, or boats               | 148 | On the beam   |
| 113 | Attack-s-ed-ing                                 | 149 | Before the beam   |
| 114 | Shall I attack?                                 | 150 | Aft the beam  |
| 115 | Begin the attack                                | 151 | Keep on weather beam  |
| 116 | Postpone the attack                             | 152 | Keep on lee beam  |
| 117 | Mean to attack the enemy as soon as possible    | 153 | Bear-s-ing-borne-bearer-s   |
| 118 | Have, or has, been attacked by                  | 154 | How did she, or it, bear?   |
| 119 | Cannot be attacked                              | 155 | She, or it, then bore   |
| 120 | Shall, or will you attack?                      | 156 | Bearings and distance   |
| 121 | To be attacked                                  | 157 | Bear up together  |
|     |   | 158 | Bear up in succession   |
|     |   | 159 | Bear up   |
|     |   | 160 | Bear up together, and preserve the starboard line of bearing, steering the course indicated |

161	Bear up together, and preserve the port line of bearing, steering the course indicated	180	Return on board
162	Form starboard line of bearing	181	Remain on board
163	Form port line of bearing	182	What vessels have you boarded?
<i>Note.</i> —By the line of bearing is meant that the ships, or boats, are to bear from each other on the point of the compass on which they would sail when on a wind, if formed in a line ahead, on the starboard or port tack.		183	Bring master on board with papers
164	Ranged on the line of bearing, but ship too much to starboard	184	Quit immediately, and come on board
165	Ranged on the line of bearing, but ship too much to port	185	Embark, and come on board
166	Blockade-s-d-ing	186	Bring boat, or vessel, on board
167	Declared in a state of blockade	187	Board the vessel, or vessels, pointed out
	Still continues in a state of blockade	188	Prepare to board
168	The blockade is taken off	189	Boat-s-ing
169	Blockade the entrance of	190	Will send a boat
170	Is, or are, blockading	191	Cannot send a boat
171	Has broken the blockade	192	Send me a boat
172	Board-s-ed-ing	193	Boat is on shore
173	In want of boarding pistols	194	Have, or has, lost a boat
174	In want of boarding pikes	195	Send boat-s at
175	Light-house board	196	Search that boat
176	Got on board	197	In your boat
177	Have, or has, on board	198	In my boat
178	Is not on board	199	How many boats?
179	Come on board	200	Guard-boat-s
		201	Boat's crew-s
		202	Boats to assemble on the off side
		203	Boats to assemble on the near side
		204	Gunboats to
		205	Gunboats to go in shore and cover the troops
		206	Gunboats to be in readiness for
		207	Flat-boats to assist in
		208	Flat-boats to be on shore by

## NAVAL SIGNALS.

The following brief description of the United States naval codes of signals, is based upon information received from Rear Admiral CHARLES H. DAVIS, U. S. N., the former chief

of the Naval Bureau of Navigation, and from Commodore THORNTON A. JENKINS, U. S. N., the present chief of the Bureau. The values and colors of the Signal Flags change frequently and are arbitrary.

THE SIGNAL SYSTEM OF THE UNITED STATES NAVY embraces a *Signal Code* and a *Telegraphic Dictionary*, each being used through the medium of *signal numbers*, as the *ciphers*, or distinctive representatives of signal communications. Both the Code and Telegraphic Dictionary are alphabetically arranged.

### THE SIGNAL CODE.

*The Signal Code* is a collection of Signals completely expressed in connection with their representative ciphers, or signal numbers, and comprises commands of evolution in naval tactics, and various orders, instructions, questions, answers, phrases, etc., of most frequent use in the naval service. It also embraces the names and corresponding signal numbers of all vessels on the Navy List of the United States.

Signal communications are effected by showing, in the authorized symbolic form, the signal numbers which respectively represent the signals to be made.

### THE TELEGRAPHIC DICTIONARY.

*The Telegraphic Dictionary* is an auxiliary to the Code of Signals in extending the range of signal correspondence. It consists of an *Alphabet* and *Vocabulary*, with a corresponding series of signal numbers.

Signal communications are made through the medium of the Telegraphic Dictionary in two ways: first, by composing the desired communication from words in the vocabulary, the words being separately shown in successive signals;



secondly, by composition from words *not* in the vocabulary, the communication being *spelled out* in successive signals of the letters of which the words are composed. A communication may also be made partly from the alphabet and partly from the vocabulary.

### THE COMMERCIAL CODE.

Besides the Navy Code, there are several well-known codes of signals recognized by the commercial marine of different nations, which it is expedient to notice in this place, because it is necessary to make use of some one of these codes for the purpose of signal communication between vessels of the navy and commercial vessels.

Of these, the most prominent are, "The Universal Code," of the late Captain Marryatt, of the royal (English) navy; "The Code International," of Captain Reynold, of Paris; and "The Commercial Code," of the British Board of Trade. The first and second codes use *signal numbers* as ciphers of signal communication; while the third, or Commercial Code, uses *signal letters*, permuted in sets of two, three, and four each, for the same purpose.

The Commercial Code, being largely used by American and British merchantmen, is, by a general order of the Navy Department, issued to all vessels of the United States navy, together with the necessary signal flags as a means of facilitating communication between the latter and the former.

The Commercial Code, in addition to General Signals, Alphabet, Vocabulary, Geographical Names, etc., contains, in a separate volume, an English and American Marine List of both war and commercial vessels.

## METHODS OF SYMBOLIZING SIGNAL NUMBERS.

*The Signal Numbers*, in both the Navy Code and Telegraphic Dictionary, commence with the number 10, and terminate, the former in four figure numbers, the latter in five figure numbers.

For symbolizing the signal numbers, two methods for general use are authorized by the Navy Department. These are: first, the old method of *Colored Flag and Light Signals*, recently improved in certain respects; and, secondly, the new method of *Chronosemic Signals*. The first is designed for ordinary use, during day or night, in the *absence of fog*; and the second is designed for use, during day or night, in the *presence of fog*. The latter, however, being adapted to general use, with the aid of the simplest apparatus, may be employed whenever it shall be deemed expedient.

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## NAVY COLORED SIGNALS.

## FIGURE SYMBOLS.

*The Colored Signals* of the Navy are based upon the use of *colored flags* during the day, and *colored lights* during the night.

Each system comprises ten distinct *figure-symbols* for the respective elemental figures,

0, 1, 2, 3, 4, 5, 6, 7, 8, 9;

and, in addition, certain *auxiliary symbols*, of use in signal operations.

*The day figure-symbols* consist of ten rectangular flags of uniform size. These flags exhibit the single colors, *white*, *red*, *blue*, respectively; double combinations of the same

# PLATE II.

## SIGNAL FLAGS & LIGHTS

FLAGS

COSTON  
LIGHTS

FLAGS

COSTON  
LIGHTS



ROCKET  
at Night  
in place of  
Cornet

Cornet



Guard Flag

To be carried  
at the  
fore royal  
Mast head



colors, in triangular halves, *white-red*, *red-blue*, *blue-white*; triple combinations of the same colors, in equal horizontal divisions, *white-red-white*, *red-white-red*, *blue-white-blue*; and a double combination, consisting of a *white* field, bearing a *blue* cross. (Plate II).

The *night figure-symbols* are colored flames or lanterns, and show the single colors, *white*, *red*, *green*; double consecutive colors, *white-red*, *red-green*, *green-white*; triple consecutive colors, *white-red-white*, *red-white-red*, *green-white-green*, respectively; and the double consecutive colors, *white-green*. (Plate II).

It should be noted that, in these symbols, the green color of a light is regarded as the counterpart of the blue color of a flag; and, with this qualification, it will be observed that the same order of succession of the simple colors, in both flags and light, and the same compound arrangement in the flags, and successive illumination in the lights, correspond to the same figures in the entire series, from 0 to 9 inclusive.

### SIGNAL NUMBERS.

A *Signal Number* is represented, during the day, by hoisting, in the required order, the *flag symbols* which show the several figures of the number, reading from above downward; and, during the night, by exhibiting in rapid succession, the *light symbols* which show the several figures of the number in their natural order.

Signal numbers which contain one or more repetitions of the same figure, if made by flags during the day, require the use of *repeaters*. These are colored triangular flags, and are distinguished as the *first*, *second*, and *third repeaters*. (Plate III.)

The first repeater shows a red field with a white rectangle at the base, and is used to repeat the first figure;

the second repeater shows a blue field with a white rectangle at the base, and is used to repeat the second figure ; and the third repeater shows a white field with a blue rectangle at the base, and is used to repeat the third figure. (Plate III.)

The following examples illustrate the use of repeaters in showing signal numbers :

<i>Numbers.</i>	<i>Symbols.</i>
2029.....	2. 0. $R_1$ . 9 ;
1335.....	1. 3. $R_2$ . 5 ;
5644.....	5. 6. 4. $R_3$ ;
7505.....	7. 5. 0. $R_2$ ;
6666.....	6. $R_1$ . $R_2$ . $R_3$ ;
22226.....	2. $R_1$ . $R_2$ . $R_3$ . 6 ;

in which  $R$ , with the proper subscript, represents the repeater to be used in such cases.

### AUXILIARY SYMBOLS.

The *auxiliary symbols*, which are used in connection with the figure symbols, are five in number, under the following names : *Preparatory*, *Answering*, *Interrogatory*, *Numeral*, and *Cornet*.

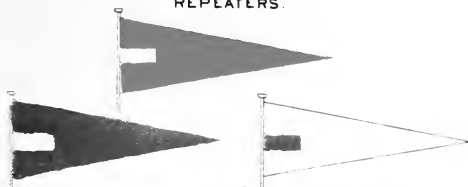
The *Preparatory*, for day use, is a triangular flag, with a triple arrangement of colors, *blue-white-blue*, in equal lengths ; for night use, it is a light of a single color, *white*.

The *Answering*, for day use, is a triangular flag, with a triple arrangement of colors, *white-red-blue*, in equal lengths ; for night use, it is a light of triple consecutive colors, *white-red-green*.

The *Interrogatory*, for day use, is a triangular flag, with a triple arrangement of colors, *white-blue-white*, in equal lengths ; for night use, it is a light of triple consecutive colors, *white-green-white*.

# PLATE III.

## REPEATERS.



### SIGNAL PENDANTS

### COSTON LIGHTS



Answering

A



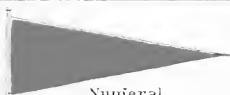
Preparatory

PP



Interrogatory

I



Numeral

N



Boat Signal Code

B



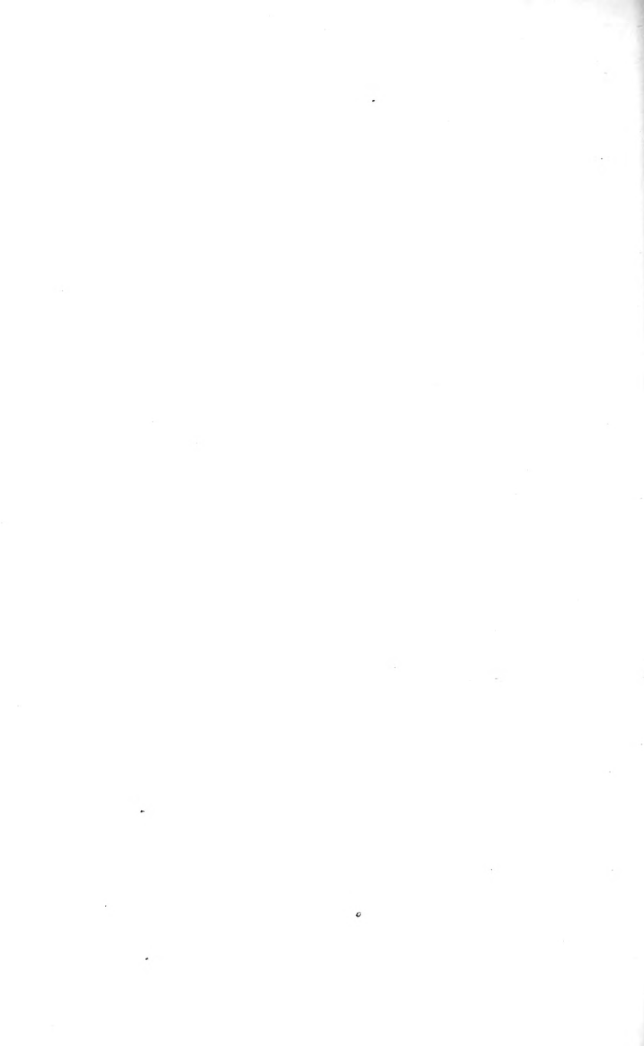
Navy Blue Light



Geographical

G







The *Numeral*, for day use, is a triangular flag, of the single color, *red*; for night use, it is a light of double consecutive colors, *green-red*. (Plate III.)

The *Cornet*, for day use, is a rectangular flag, of two colors, *white-red*, in alternate right-angled quarter sections; for night use, it is a rocket. (Plate II.)

### GENERAL INSTRUCTIONS.

The flags will be made of the best quality of bunting, in material, and in brilliancy and fastness of colors. The proportions of the flags, as well as their absolute dimensions, which are variable for different classes of vessels, will conform to the Navy Regulations.

The light symbols will consist of the colored flames known as the "Coston Night Signals," or of lanterns fitted with suitably arranged colored glasses.

Each Coston signal of a single color, for example, for the figures 0, 1, 2, burns 14 seconds; each symbol of double colors, as 3, 4, 5, 9, continues 28 seconds; and each symbol of triple colors, as 6, 7, 8, continues 42 seconds.

Care will be observed, by the person appointed to observe distant signals, to avoid, as much as possible, looking at the brilliant flames of the Coston signals burning near him, in order not to injure his perception of the different colors of the distant signals.

The example of a Naval Code, on a preceding page, illustrates the great variety of messages that may be arranged for codes of this kind. (See page 47.) The values and colors of Naval Signal Flags and Lights are changed constantly; and those here given are shown for illustration only.

## GENERAL APPLICATIONS.

It is difficult to realize, without reflection and the illustrations of actual example, that on the simple rules just given, must have been based, from the beginning of the world, all signal systems of whatever character; and that, by the simplest and easiest modes, following these rules, intelligible communication may be had by devices absolutely infinite in number, and plans extending in their application to every perception of which human sense is capable, and to every thing in existence to which attention can be directed. There is no thing, or sight, or sound, or motion, or taste, or odor, perception, sensation, or indication, but by which or through which ideas and meanings may be intelligibly transmitted, and which may thus be used for signal communication. Says CHATFIELD, "It seems, at first sight, very singular that a blind child should be taught to read; but observe what the common process is with every child: a child sees certain marks upon a plain piece of paper, which he is taught to call A, B, C; but if you were to raise certain marks in relief upon pasteboard, as you may of course do, and teach a blind child to call these marks which he felt A, B, C, a blind child would as easily learn his alphabet by his fingers as another would do by his eyes, and might go on feeling through HOMER or VIRGIL as we do by persevering in looking at the book. 'Just in the same manner,' says SYDNEY SMITH, 'I should not be surprised if the alphabet could be taught by a series of well-contrived flavors; and we may live to see the day when men may be taught to *smell* out their learning, and when a fine scenting-day shall be (what it certainly is not at present) considered as a day peculiarly favorable to study.'"

Through every sense there may be received or caused different sensations.

Any number of these different sensations, of any sense, may be taken as those to be caused or to be understood as the elements of any system of signals.

If these are now produced in sequences or arrangements, following the principles and the rules of signals just illustrated, it is plain there may be devised systems of signals for any sense; the signal being as readily understood, and conveying to the mind the same meaning, through whatever sense it reaches it.

The principles of signals are immutable. The applications of these principles are endless. To treat of the modes of making signals, is only to describe the infinite devices in which human ingenuity exhausts itself to best make these applications. Novelty as to the principles is impossible. There is scope for invention and discovery only as to the ingenious application of principles well known for centuries, and the mechanical devices to make those applications most available.

The object of all signalling is, to convey ideas; or to converse at a distance. Telegraphing, in its widest signification, is only conversing by a sign-language. Signalling is telegraphing. Language itself is a conventional system of signals which, by long practice, we use skilfully. Signalling, as is generally understood by the term, has been erroneously limited to preconcerted sentences; because the means employed were ineffective to rapidly transmit all the phrases of language. The perfection of signalling or telegraphing, is to be able to transmit any terms of any language with precision and dispatch without preconcerted codes.

To illustrate the many means which can be used for signals, the following examples are given:

## SIGNIFICATIONS BY POSITIONS (PLATE IV.)

If in Fig. 1 the arm *a* is inclined obliquely downward and on the right of the upright *u*, as at *a*, this position may be assumed as a primary signal or an element.

The arm placed horizontally on the same side of the upright, as at *b*, (Fig. 2), is another signal.

The arm inclined obliquely upward, and on the same side of the upright, as at *c*, (Fig. 3), is a third signal; and so on, through all the different and the distinct positions *d*, *e*, *f*, *g*, in which the arm can be placed, (Fig. 4).

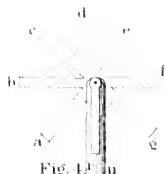
Let the signals be designated by figure-symbols, as by 1, 2, 3, etc., and it is evident the given rules will determine the number of indications which can be made.

Thus the positions "1, 2," made together, one after the other, would be one signal. The positions "1, 3, 2," a different signal. The positions "2, 1," a third signal. If now, "1 2," stands for A, "1 3 2" for R, and "2 1" for E, these three signals, made in this order, would signify the word ARE. It is plain, that with any twenty-six signals made after this fashion, by combining the three positions, we could make all the letters of the alphabet.

To make signals by positions, there is needed one fixed position, to which all the others may be relative, as the head of the upright in this case, and some mode of indicating what signals are to be taken together; as in this case a swing of the arm (*a*), to be made at the end of each combination; or letting it start from the position *r*, (Fig. 4), at the beginning of each combination signal, and return and rest in that position at the close of each signal; or any other agreed sign may be used. This signal has been before mentioned as the "pause-signal." Upon plans such as these, more elaborated, most semaphores are devised.

Now the positions may be any positions of any of the most common things, and they may be exhibited anywhere.

# PLATE IV.



1<sup>st</sup> Pos. One or "1"

2<sup>nd</sup> Pos. two or "2"

3<sup>rd</sup> Pos. three or "3"

Pos. r or rest & Pos.  
a. b. c. d. e. f. g.

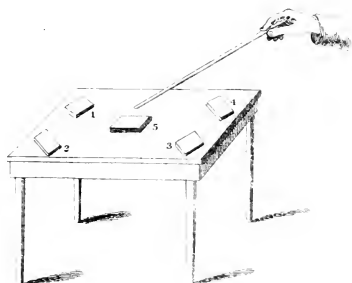


Fig. 6.

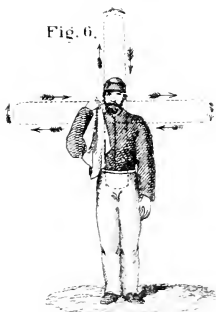
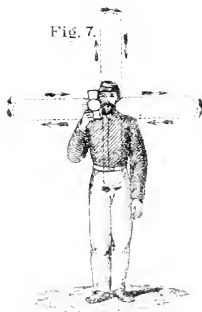


Fig. 7.





Of course the hand and arm of a man, standing upright, could be used just as well as the machine above described.

Or, to illustrate further, we can place a number of books or miscellaneous articles, lying in different positions, as relative to some central book on the table, (Plate IV., Fig. 5). Now if the different books are designated by numbers, as "1," "2," "3," etc., touching each indicates it as a signal; and touching the central book shows the beginning or end of a signal—that is, the pause-signal. Then, if we touch book "1" and "2" (the first and second), and then the centre book as a signal; then the first and third and second, or "1" and "3" and "2," and then the centre, and then the second and first, "2" and "1," and then the centre as other signals, thus touching the centre between each combination signal, we make three signals; and, as before, the letters A, R, E, the word "ARE."

Of course by further combinations, as "3 2," "1 2," etc., all the letters of the alphabet could be represented. We can vary this experiment by endless changes of the objects we use, or of their number, or of the positions assumed, and by any of them continue to send intelligible messages.

#### SIGNIFICATIONS BY MOTIONS.

If a handkerchief is held in the hand, at the height of the face, and is thence waved to the right, and to the left, and up, and down—always returning to the face at the end of each motion—four distinct motions are made. (Plate IV., Fig. 6.) These can be designated by figures, as 1, 2, 3, 4, and can be made conjoined by twos or threes or fours as signals; those motions, which are to be read together as signals, being made to follow each other so rapidly that there shall seem to be no rest between them; the handkerchief held resting at the face, indicating the completion of a signal, or being a pause-signal. Thus, if the motion to

the right is known as "one," the left as "two," the motion above the head as "three," and the motion down as "four," if we now make three signals, as "one—two," "one—three—two," "two—one," the handkerchief resting at the face between each combination signal, these are as before the letters A, R, E. As in the former instance, other combinations of these motions may represent the other letters of the alphabet. It does not need demonstration that any other motions whatever, or a greater or less number, taken together, than in these instances might be used to designate letters by signals, as simple or as complex as we choose to make them.

#### SIGNIFICATIONS BY SOUNDS.

If we can make with a bell or drum, by varying the course of the stroke, or in any way, two or three or more different sounds, as a high, a low, and a soft sound, we can designate these as "one" and "two" and "three."

It is easy to understand by preceding illustrations how, if we sound "one—two," a pause, "one—three—two," a pause, "two—one," and cease, we indicate the letters A, R, E; and how, by further combinations of these sounds, there may be given a particular signal for each letter of the alphabet. Of course sounds of any kind may be used, as notes of bugles, of pianos, or the tapping of a finger on differently sounding articles on a table, whistling, etc. It makes no difference, in the example, what may be the force of the sounds, or the number used; whether they are the reports of differently charged cannon, or the tickings of telegraphic instruments. For illustration, any person can send messages by combinations of the two sounds made by tapping on a book "one," and on a candlestick "two," the alphabet constructed, say as follows: "two—one" is "A;" "one—two—one" is "B;" "one—one—two" is "C;" and so on, combining ones and twos. Some electric telegraphs



work in this way. Messages may be sent with three sounds, as taps on a candlestick, "one;" on a book, "two;" and on a plate, "three;" as "one—two" is "A;" one—three—two" is "B;" "two—one" is "C;" and thus on. The illustration may be continued, using any number of different sounds, making alphabets in which the letters are designated by four sounds, or five sounds, etc.

#### SIGNIFICATIONS BY TOUCH.

We can cause any several different sensations by touch: as, by touching the hand with a rough body and a smooth; with a sharp point or a dull; or by a long pressure and a short; or by a different number of taps, as with a finger upon the hand. Whatever may be the different sensations caused, they can be designated by numbers. The process of making signals by touch, is as before described. Thus the rough touch may be known as "one," and the smooth as "two;" these sensations caused as follows: "two—one" may mean "A;" then "one—two—one" is "B;" "one—one—two" is "C;" and thus through other combinations of one and two through all the alphabet.

Or one finger may be touched to indicate "one;" the next finger touched be "two;" the third be "three." Then, with the combinations of one and two and three, we may make any signals.

Or four fingers may be touched, and these signals may be of all the arrangements of "one" and "two" and "three" and "four." It is evident that, continuing the experiment, every kind of combination may be made and read by touch.

#### SIGNIFICATIONS BY TASTE.

If there are articles of different tastes, as salt and sugar and mustard; or liquids, as brandy, cider, and water, these different tastes may be designated as "one" and "two" and

"three." Now if any two, as brandy and cider, are offered in succession to the taste, they make signals of meaning. Thus, "two—one" is "A;" "one—two—one" is "B;" "one—one—two" is "C;" and thus an alphabet. Or if the three are taken, then the similarly tasted signals are made by combinations of the three tastes; or the tastes may be increased in number, and furnish signals of any kind.

#### SIGNIFICATIONS BY ODORS.

If there are three perfumes, as that of the rose, the violet, and the hyacinth, these can constitute the designated elements, "one" "two" "three." If but two are taken, as the rose, "one," and the violet, "two," and the perfume of the violet and then of the rose is offered, there is the signal "two—one," or "A;" so the perfume of the rose followed by violet followed by rose is "one—two—one," or "B;" so the perfume of rose twice presented and followed by violet is "one—one—two," or "C." The alphabet of perfumed signals would follow in the variety of arrangements of these two elements.

Or using geranium, rose, violet, and hyacinth, we devise signals with the arrangements of "one," "two," "three," and "four," or of four elements; so multiplying the perfumes and their combinations, it is plain any signal whatever may be indicated by their use.

#### SIGNIFICATIONS BY COLORS.

It will be readily recognized how colors, as red, blue, yellow, green, black, may have significance. They may be designated by numbers, as one, two, three, four, five, etc.; and then, when properly represented, show all the signals that arrangements of these symbols can express. Thus, if two are used, blue followed by red, and shown one after the other; or if the colors are in flags, one shown above the



# PLATE V.

## SIGNALS BY COLORS.



Fig. 1.

Blue-red-21

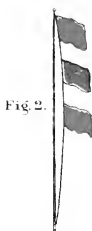


Fig. 2.

Red-blue-red-121

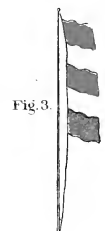


Fig. 3.

Red-red blue-112

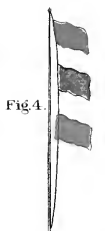


Fig. 4.

Red-blue-yellow-123

## SIGNALS BY FORMS.

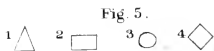


Fig. 5.



Two-one-21



One-two-one-121



Two-three-four-234

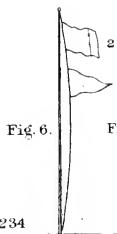


Fig. 6.

Two-one-21

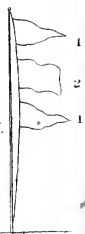


Fig. 7.

One-two-one-121.

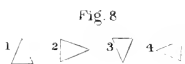


Fig. 8.



One-four-14



Two-three-23

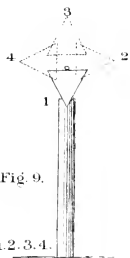


Fig. 9.

Positions 1.2.3.4.

other (Plate V, Figs. 1, 2, 3, 4), the signal "two—one" is made, or A; so "one—two—one," or "red, blue, red," indicates B; and "one—one—two," or "red, red, blue," is C; so, using red, blue, and yellow, are made signals of three elements with these colors, as in preceding examples. Or, increasing the number of colors, signals of any combination of colors may be made. The signals by colors may be permanent, as when colored flags are exhibited, or any colored objects are arranged and kept in view to make the signal; or they may be transient, as when flashes of colored lights make the signals; or the colored flames of pyrotechnic compositions are used. It is manifest that, however the colors may be displayed, their use, and the principles upon which they must be used, remain the same.

#### SIGNIFICATIONS BY FORMS.

Plate V, Figs. 5, 6, 7.—If there are different forms, as the triangle, the square, the circle, the diamond, these may be made significant: they may be designated as "one," "two," "three," and "four," etc., and then exhibited in proper combination and sequence, indicate any combination or arrangement of these elements; so if the triangle is known as "one," and the square as "two," a square and a triangle displayed, as with flags one above the other reading from above downward, or side by side reading from left to right, would be "two—one," or "A." A triangle, a square, and a triangle similarly displayed, would be "one—two—one," "121," or "B;" a square, circle, and diamond, "two—three—four," "234;" and so for any desired uses.

#### SIGNIFICATIONS BY POSITIONS OF FORMS.

A triangular form may be exhibited in different positions relatively to some position fixed, as with the apex or point

up, the point down, the point on the right, the point on the left, etc.

To these different positions of the form, significance can be given. They may be known as "one," "two," "three," and "four," etc., and when exhibited as by preceding plans have meaning. (Plate V, Figs. 8, 9.) Positions, forms, colors, positions of forms, etc., have, of course, equal meaning, whether exhibited as aerial signals, or drawn as symbols on paper.

These illustrations might be extended to infinity. They have been given to show, in a plain way, how endless are the applications of the principles of signals, and how simple is the study of the subject; to establish, by example so practicable as to be interesting that, for every sense, there are signals, and through every sense, we can converse, in a language fitted for that sense, as intelligibly as in that to which our lips give utterance. The common illustrative examples here given, should be practised. No signalist should believe that he comprehends the principles of signals, and the endless modes of their possible application, until he has himself devised alphabetic signals for each sense, and with these signals, has sent and received, using that sense alone, understandable messages.

The alphabet should be devised in different ways, and with varied numbers of elements.

In the study of semiology, the student ought to be required to illustrate the preceding lessons by exercises upon the blackboard, and to determine, by his own ingenuity, what his elementary signals shall be, and how he will combine them.

A good signalist ought to be able to use any things as signals, and to apply at any time the rules to improvise codes in many different ways. The principles must be thoroughly understood. A few days' study and practice will then so far perfect almost any persons, as to render it nearly im-

practicable to prevent them from talking, by signs of some kind, past any guards or sentries, or in spite of other restraint that may be put upon them.

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## FIELD SIGNALS BY ONE ELEMENT.

Signals of this kind are not much used for general purposes. Their employment is almost always to convey one or a few preconcerted messages. For signals of this class, one thing or indication is to be used, and the signal is not to be considered as varied, though the symbol may vary in any signal. To mark the close of each complete signal, there must of course be a pause of time, or a pause-signal. A good illustration of signals of this kind is found in the striking of a clock; twelve different hours are indicated by the same; and a single sound, repeated the proper number of times to suit each hour. The beat of sound is here the signal element. If in the striking of any hour, this sound varies so as to make two or three different notes even, this difference of sound affects, in no way, the meaning of the signal. Signals of this kind may be used in the field, as where one rocket is thrown up to indicate any one message; two rockets, a second message; three rockets, a third message; and thus on to any given number.

Or a light may be shown a certain number of times, as a candle shown at a window and then removed, to stand for "one," or the first message; shown twice for "two," or the second message; three times for "three," or the third message; and thus on. Or, in a field or in a boat, a lantern may be kept lighted in a pail, and hoisted out of the pail and returned to it to make each flash. Or a lantern may be shown from behind a fence, or any kind of screen. In these illustrations, the flash of the light is the signal. Each com-

plete signal may be shown by a wave of the light, or any other sign, as the pause-signal. Or guns may be fired the required number of times for any signal.

Now, in any of these signals, which are to depend upon the number of times a light is shown, or the number of times a gun is fired, no difference of meaning is made, if the light changes, or if there is difference of sound in different reports of the gun; for it is remembered one element only is used, and that the signal depends solely upon the number of repetitions of that element. For instance, a white light shown twice, would stand for message number "two." A white light shown, and then a red light, making two in all, would also stand for "two." So the preconcert being that one element only is to be used in a set of signals, they may be made to seem much varied.

Signals of one element, when used in the field, are generally for instances as these: to fire two guns to indicate a completion of a military movement; to throw up three rockets, or one rocket, to announce that a portion of the army is to move. Of course several such messages can be arranged in one code.

#### EXAMPLE OF A CODE.

A rocket, gun, stroke of a bell, drum-beat, steam-trumpet blast, to stand for each unit of number.

I, Army attack.	} This might be written :	1, Army attack.
II, Gunboats open fire.		2, Gunboats open fire.
III, We are in position.		3, We are in position.
III, Fire rapidly, etc., etc.		4, Fire rapidly, etc., etc.

The characters in either column indicate the same designating signals;—the character I in the first column indicating by each of its repetitions the repetition of the signal for which it stands.



The signals of such a code may be flashes of light, or beats of sound, or colored flags, or separate motions, or any indications which can be made distinct, and in such way that they may be counted.

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## FIELD SIGNALS BY TWO ELEMENTS.

The plan of signals most used in the army is one by two elements. The systematizing of signals, using a basis of two elements only, permits illimitable applications at once so much more simple and more varied than any other, that it has seemed best adapted for general use. The most ancient systems of which there is record, can be reduced to this principle of formation, and later invention has been able only to apply the principle with more skilful system and in more efficient modes.

In time of war, the intelligent co-operation of the army and navy becomes essential to the success of many operations.

The same alphabetic code of signals should then be used by both forces, and the same plans of cipher, distributed to chosen officers of the army and navy, should enable the communication to be by either concealed from the enemy. The signal service of the United States will not be complete until it has been so extended, that every vessel of our navy can be certainly, whenever in view, in communication with each post on land, and with every considerable body of land forces.

The following General Service Code was prepared to secure this communication:

## GENERAL SERVICE CODE.

(AN ARRANGEMENT OF TWO SYMBOLS.)

A, .....	22	P, .....	1212
B, .....	2112	Q, .....	1211
C, .....	121	R, .....	211
D, .....	222	S, .....	212
E, .....	12	T, .....	2
F, .....	2221	U, .....	112
G, .....	2211	V, .....	1222
H, .....	122	W, .....	1121
I, .....	1	X, .....	2122
J, .....	1122	Y, .....	111
K, .....	2121	Z, .....	2222
L, .....	221	&, .....	1111
M, .....	1221	ing, .....	2212
N, .....	11	tion, .....	1112
O, .....	21		

3—End of a word.

33—End of a sentence.

333—End of a message.

22.22.22.3—Signal of assent: "I understand," or "message is received and understood," or "I see your signals," or affirmative generally.

22.22.22.333—Cease signalling.

121.121.121—Repeat.

212121—Error.

211.211.211—Move a little to the right.

221.221.221—Move a little to the left.

Flag waved successively from side to side until attention is attracted—"Attention, look for signals from this point."

## NUMERALS.

1. 21112—Wait a moment.

2. 12221—Are you ready?

# PLATE VI.



First Position - or "Ready"



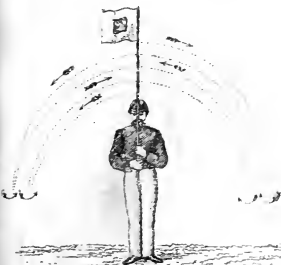
First Motion - "One" - "1"



Second Motion - "Two" "2"



"One Two" - "12"



"Two - One - Two - One" - "2121"



"Three" - "3" or Front



3. 22122—I am ready.
4. 22212—Use short pole and small flag.
5. 22221—Use long pole and large flag.
6. 12222—Work faster.
7. 11222—Did you understand?
8. 11112—Use white flag.
9. 11211—Use black flag.
0. 22222—Use red flag.

When the numerals are used in transmitting messages as code signals, they have the meanings given above, opposite each character.

a—after.	b—before.	c—can.	h—have.
n—not	r—are.	t—the.	u—you.
ur—your.	w—word.	wi—with.	y—why.

The Roman letters may be used instead of numeral characters. Or the first ten letters of the alphabet may be used as indicated at page 41.

The signal for “the address of the message is now complete,” is made thus: the flag, being in the first position is dropped to the front, and then waved in full circles twice to the right, passing over the head. It then resumes the first position. The signal for “the message is signed as follows,” is made thus: the flag, being in the first position, is dropped to the front, and then waved in full circles twice to the left, passing over the head; it then resumes the first position.

This code, distributed to the different posts or vessels, is accompanied by a card as follows, on page 404.

The use of this card is for reference. It may be carried in the pocket-book.

The “General Service Code” is intended to be used for general communication between different parties on land, or between vessels, or between vessels and parties on land.

It is for the purpose of transmitting such messages only as may constantly occur in service, and concerning which it does not matter whether they are interpreted by the enemy or not.

Ciphers, either to be agreed upon by particular commanders or published generally through the command, must always be used in the transmission of messages of importance, or for any communication which might give information to an enemy.

#### INSTRUCTIONS FOR USING THE CODE.

The whole number opposite each letter stands for that letter.

The numbers are made, by motions of the flag or signal, to the right or left or in front of a vertical position.

#### DAY SIGNALS—MOTIONS OF FLAGS.

To make day signals, there being furnished the Regulation set of Signal Equipments, a flagman, standing, holds in his hand a plain signal-staff, eight or twelve feet long, having a signal flag attached to its upper extremity.

#### POSITIONS AND MOTIONS.

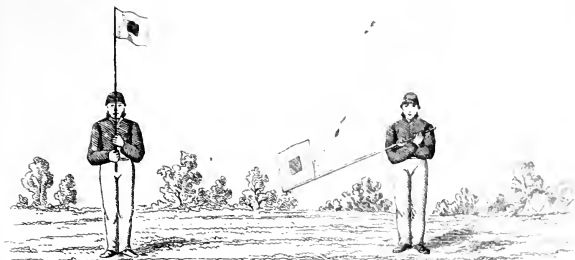
There are one Position and three Motions. (Plates VI. and VII.)

The FIRST POSITION is with the flag held directly above the head of the flagman, the butt of the staff at the height of the waist, and grasped by both hands, the hands separated from each other about eighteen inches.

To make the FIRST MOTION, or "one" or "1," the flag, being at the first position, is waved to the ground to the right, and instantly returned to the first position.

To make the SECOND MOTION, or "two" or "2," the flag,

# PLATE VII.



First Position-or "Ready"

First Motion-One-"1"



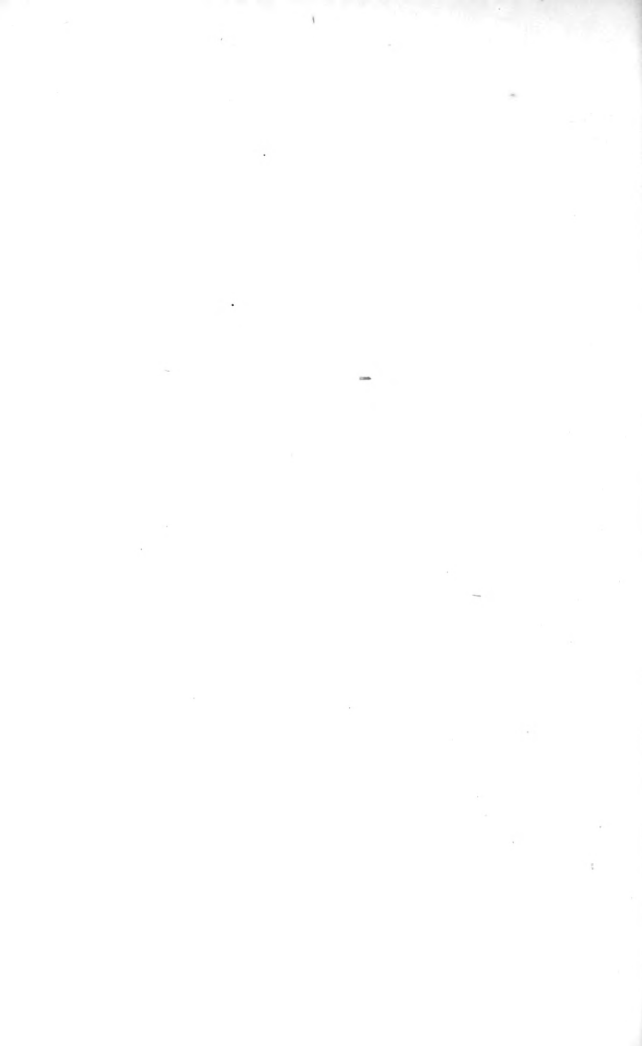
Second Motion-"Two"- "2"

"Two-One" - "21"



"One-Two-One-Two"- "1212"

"Three"- "3"- or-"Front"





being at the first position, is waved to the ground to the left, and instantly returned to the first position.

To make the **THIRD MOTION**, or "three" or "3," the flag, being at the first position, is waved to the ground directly in front of the flagman, and instantly returned to the first position.

The "first motion" is known for the signal "one," and is indicated by the numeral "1."

The "second motion" is known for the signal "two," and is indicated by the numeral "2."

The "third motion" is known for the pause-signal "front," or signal "three," and is indicated by the numeral "3."

When the number is a single figure, but one motion of the flag, to the right or left, is required to make it.

When the letter-number consists of more than one figure, the motions of the flag for each figure follow each other without any pause between them. When the flag stops in the vertical position, it indicates that the letter is completed.

Thus to make "I," or "one" or "1," the flag is waved once to the right (right) and then pauses in the first position.

To make "A," or "two two," or "22," the flag is waved without pause twice to the left (left left) and then brought to the first position. So for any number of "twos" following each other.

To make "B," or "two one one two" or "twenty-one twelve" or "2112," the flag is waved, without pause, once to the left, twice to the right, then to the left (left right right left), and then brought to the first position—that is, one "second motion," followed by two "first motions," followed by one "second motion," the flag not stopping between the motions.

To make "C," or "one two one" or "121," the flag is waved, without pause, once to the right, once to the left, and then to the right (right left right), and then brought to the

first position—that is, one “first motion,” followed by one “second motion,” followed by a “first motion,” the flag not stopping between the motions.

To make three “fronts” or “three three three” or “three-thirty-three” or “333,” the flag is waved directly to the front to the ground three times without pause, and then returned to the first position.

The code, as printed, indicates accurately the flag-motions or waves for each letter.

At the end of each letter the flag remains in the first position about two seconds, to show that the letter is finished.

### TO SEND A MESSAGE.

First call “attention” by waving the flag successively from side to side, until it is seen and answered by the opposite station. The station call will “answer” by making 22. 22. 22. 3, the general signal for assent or affirmation, to signify that it is ready to receive the message. The communicating station then makes 22. 22. 22. 3, signifying, “I see you are ready to receive the message,” and then proceeds to transmit the message, letter by letter. A pause is made at the end of each letter. At the end of each word, the flag is waved to the ground, directly in front (“3,”) to show that the word is finished. At the end of each sentence, there is a pause, and the flag is waved to the ground twice, directly in front (“33,”) to show that the sentence is finished. At the end of a message, the flag is waved to the ground three times, directly in front (“333,”) showing that the message is finished.

When the signal “333,” “end of message,” is made, it indicates, “My communication is complete; I await your answer.” The station receiving the message will, upon noticing the signal “message complete,” if the message has been correctly received, immediately answer, with the signal of

assent, "22.22.22.3;" and will then, if the sending station has finished, signal in turn such messages as it may have to communicate. If, however, the message, or any part of it, has not been correctly received, or is not understood, the receiving station will make the signal for "Repeat," "121.121.121.3," followed by the part of the message to be repeated, as "121.121.121.3 after or before the word —(here signal the word after or before which the repeat is required)." If the message is not understood at all, the signal "121.121.121—all" is made. In commencing a repetition, the sending station will always commence by making the "signal of assent," to show that the call for "repeat" is understood.

This "signal of assent," meaning "I understand," will be used habitually at the commencement of all communications.

When, in the transmission of a message, a mistake is made, as may happen by the error of the signalist or of the flagman, the "error signal" "212121.3" is made. The sender then, beginning with the letter in which has been the error, signals it correctly, and proceeds with the message.

To make clear the mode of signalling, let us suppose the word "able" is to be signalled. The receiving station has been called with the "attention signal," and has answered with the "signal of assent." The signalist now makes "22.22.22.3," both to show that he has seen the "assent," and that the receiver may be sure he sees the first letter. Then there are made, first, the signal numbers of the letter "A," "22;" there is then a pause of two seconds, the flag being in the first position. The signal numbers of the letter "B," "2112," are then made, followed by another pause. Then the signal numbers of the letter "L," "221," succeeded by another pause. The signal numbers of the letter "E," "12," are then made. The flag is then dropped to the front ("three" "3"), returning to the first position to indicate that

the word is ended,—and thus, in a message, word by word, until the message is completed.

The signal “address complete” is made just after the address; and the signal “message signed” is made just before the signature.

At the close of the message the signal “333” is made.

The receiver acknowledges the message correctly received by the signal of “assent;” or, if it is not understood, he proceeds as before indicated.

### ORDERING SIGNALS.

When signals are made with the Regulation Signal Equipment and by a flagman detailed and practised for the purpose, the flagman properly placed and equipped and standing with the flag and staff in the “first position,” each signal is ordered by calling off briskly, as an order, the numbers for the signal,—the flagman making promptly, on hearing each order, those motions with the flag indicated by the signal numbers ordered. Each letter-number must be called plainly, distinctly, and clearly by itself, that the flagman may know, before commencing the signal, what numbers are to be made together without pause, so that the motions may be made rapidly and well timed. Thus, in orders, “A” “22” would be ordered by calling “twenty-two;” “B” “2112,” by calling “twenty-one twelve;” “C” “121,” “one-twenty-one,” Signal “3” “three,” Signal “33” “thirty-three.”

In the same manner, the signalman being beforehand thoroughly drilled in the working, the orders may be given for whatever apparatus—each signal being made as directed for the particular apparatus on the hearing of the order.

With practised signalmen, the letter, word, or clause of a sentence to be transmitted, may be given in words and without the orders for the signal numbers, unless the message is to be in cipher.

When in actual service, the signals are made wholly in cipher; and the greatest care is needed both in the ordering and in the record.

### RECORDING SIGNALS.

When circumstances render it necessary, a pause will be made at the end of each sentence, to permit that sentence to be accurately written down. With skilled signalists, such pauses are not necessary. Each signal number may be taken down with a pencil as soon as it is seen, and afterwards translated by reference to the code. When the signalist is accustomed to the code, this may be dispensed with, and only the words and sentences are written down during the pauses. When two men are together at a station, one man looks through the glass and calls the numbers, as fast as they are seen, to the other, who writes them down. Messages are thus recorded in the signal numbers composing them. This is done by writing for each letter the signal number which stands for it; thus the word "W A S," written in signal numbers is, "1121 22 212," each letter in signal numbers being separated from the next by a small space. Each complete word is separated from the next by a dash; as "W A S—N O T," is in signal numbers, "1121 22 212—11 21 2."

When secret or cipher codes, codes devised for the occasion, or codes not before used, are employed; or when the commander wishes a message signalled of which he and his correspondent alone shall know the meaning, the message may be thus reduced to signal numbers, which may be secret, before being placed in the hands of the signalist, who then becomes simply a medium for the transmission of the message, without knowledge of its contents. By this plan of reducing a message to its signal numbers written upon paper before it is sent, and of recording upon paper

the signal numbers made by others as they are received, translating them afterwards by the code, it will be found that messages may be almost immediately exchanged, though slowly, by those having knowledge of the principles of the codes without the study or practice of any particular code.

In calling off, from the glass, signal numbers to be recorded in writing, each signal number must be called, distinctly and completely, by itself; as, for instance, "one twenty-one" "twenty-two" "one twelve," and so on.

The rules for sending, receiving, ordering, and recording are of general application, whatever style of signals may be used.

#### DAY SIGNALS—VERTICAL MOTIONS.

Let there be an upright rod or standard (Plate VIII, Figs. 1, 2, 3, 4) projecting, as above the roof of a house or the deck of a vessel, on which the signal ball B can be moved freely up and down by halyards, or by a light "moving-rod" moving in a groove in the upright.

The moving-rod, to which the signal ball is attached, extends below the deck or roof, where it can be grasped and worked by hand. The upright rod is called the "signal staff,"—it should be about five feet long. The centre of the signal-staff is the point of reference and of rest.

The "first position" is when the signal ball is at the centre or point of reference.

The ball being at the first position :—

To make the "first motion," the signal "one" "1," the signal ball is moved rapidly to the top of the signal staff and instantly returned to the first position.

To make the "second motion," the signal "two" "2," the signal ball is moved rapidly to the bottom of the signal staff and instantly returned to the first position.

To make the "third motion," the signal "three" or "3,"

# PLATE VIII.

Fig. 1



Pos. Ready

Fig. 2



Mot. one

Fig. 3



Mot. two

Fig. 4



Pause Signal

Fig. 5



Ready

Fig. 6



Mot. one

Fig. 7



Mot. two

Fig. 8



Pause Signal

Fig. 9



Mode of Sending up Flags



Ready



Motion 2



Motion 1





the signal ball is moved rapidly in what is called a half motion, a little above and then a little below the point of reference, and instantly returned to the first position.

The same ball, resting at the point of reference, is the pause-signal, to denote the completion of any letter-signal.

The length of movement which can be most conveniently given to the signal ball, when worked by a "moving-rod," is about the length of the arm above the centre of the signal staff to make the "ones," and about the same length below that point to make the "twos."

To work the signal ball, the signalman, standing under the deck or inside the house, holds, grasped in his right hand, and at the height of his shoulder, the handle of the moving-rod, as at Plate VIII, Figure 1.

The signal staff and the moving-rod are so proportioned that the signal ball is then at the point of reference. This is the first position, or "ready."

To make the "first motion," "one" "1," the right arm, the hand grasping the handle, is quickly extended the full length of the arm, above the head, and instantly returned to the first position.

To make the "second motion," "two" "2," the right arm, the hand grasping the handle, is quickly extended the full length of the arm, below the shoulder, and instantly returned to the "first position."

To make the "third motion," "three" "3," a short, quick motion is made, above and below the shoulder, with the hand grasping the handle.

In this way, the ball, being at the first position, to signal "A" "22," the hand and rod-handle are carried twice at arm's length, below the shoulder, and at once returned to first position; the signal ball moves rapidly twice to the foot of the standard and then resumes the first position.

To signal "P" "1212," the hand and rod-handle are carried, without pause, once at arm's length above the

shoulder, then once at arm's length below the shoulder, then again at arm's length above the shoulder, then again at arm's length below the shoulder, then return to first position; or there is made one first motion, followed by one second motion, followed by one first motion, followed by one second motion, "one-two-one-two." The signal ball is moved, without stopping, once to the top of the standard, then once to the foot of the standard, then again to the top, then again to the foot, and rests at the first position. To make "C" "121," the signal ball is moved once to the top of the standard, then, without pause, to the foot of the standard, then again to the top, and rests at first position. To make "Y" "111," the signal ball is carried three times to the top of the standard. To make "E" "12," the signal ball is carried once to the top and once to the bottom. To make "33," the signal ball describes quickly two "half motions."

At the completion of each signal letter, the signal ball rests at the centre of the staff, the point of reference.

A modification of this plan is at Plate IX, Fig. 5;—a signal ball B fitted to traverse on a signal staff, and moved by the halyards H H, attaching to the upper and lower sides of the ball, and passing through pulleys at the top and bottom of the signal staff.

The point of reference, the positions, motions, and pauses of the signal ball are similar to those just described.

To work the halyards there are one position and three motions.

The "first position," the signalmán standing, one cord of the halyard grasped in each hand, hands at the height of and in front of the shoulder. From this position—

To make the "first motion," extend at the same moment the left arm and hand at full length above, and the right arm and hand at full length below the shoulders. Resume the first position.

To make the "second motion," extend at the same moment the right arm and hand at full length above, and the left arm and hand at full length below the shoulders. Resume the first position.

To make the "third motion," the left and right hands are raised a little way alternately, and then return to first position.

To signal "E" "12," extend the left arm up and the right arm down, "one;" then immediately reverse the position, extending the right arm up and the left arm down, "two." Resume the first position.

To signal "C" "121," extend the left without pause up, and right down, "one;" the left down, and right up, "two;" the left up, and right down, "one." Resume the first position.

The motions and positions of the arms can be readily understood by Plate VIII, Fig. 9.

The length of motion given the signal ball is, when the halyards are worked by hand, about four feet above and below the point of reference.

The halyards can be carried over a light-grooved wheel at the foot of the mast in such a way that these signals can be rapidly and accurately displayed, and with a greater length of movement.

The wheel is worked by a flagman.

Signals made in this manner have the advantage that they can be read **at** the same time from different directions.

A plan of signals by vertical motions is shown Figs. 5, 6, 7, 8, Plate VIII.

Let there be a short marker-rod, having at its top end, and about an arm's length above the roof, a marker-ball. This is the point of reference. Near this marker, and working freely vertically through the roof, is a signal rod, bearing at its upper end a signal ball. This signal rod is of such length that it extends below the roof a sufficient distance to

permit of its being worked by hand to make the signal motions, and when grasped by the hand, held at the height of the shoulder, brings the signal ball close to and at the same elevation as the marker-ball. The balls so placed are in the "first position," the "rest," or "ready."

The motions, positions, half motions, and pauses of the signal ball are made for signals in the same way, and have the same meaning as the vertical signals first above described. (Plate VIII.)

This plan can be very simply applied without any apparatus. Thus a signal staff, having at its end a signal ball or a signal of any kind, so that it is visible, can be thrust through the roof or deck or any part of any structure, and moved up and down or back and forth to make signals,—some particular part of the structure affording a point of reference, by reference to which the direction of the movements can be judged. It is necessary only to know where the ball rests, as at its point of reference, and to be able to determine when it moves above and below that point, and when it returns to it, in the formation of signals.

So a ramrod, having a handkerchief bound around its end, can be projected into view from any part of a house or vessel, and used as a signal staff. Or any rod, eight or nine feet long, with a hat or flag of any kind fastened to it, will be a sufficient signal rod.

An established "point of reference" insures accuracy, however, and one can be so easily set up that the marker ought always to be used when it can be.

The illustrations at Plate IX, Figs. 1, 2, 3, 4, afford examples of possible applications of these plans in service. All the parts of the apparatus may be of the most simple structure, of articles that are almost always at hand.

# PLATE IX.

Fig. 1



Fig. 2.

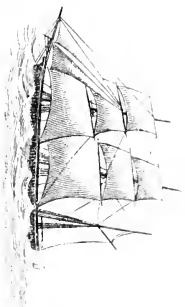


Fig. 3.

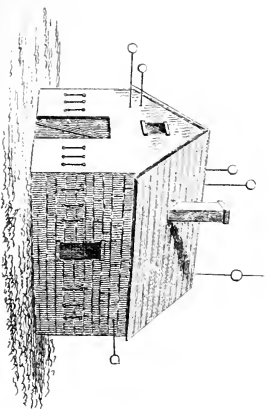


Fig. 4.

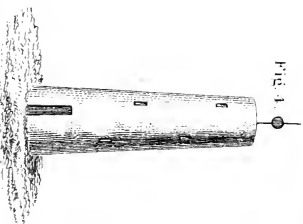
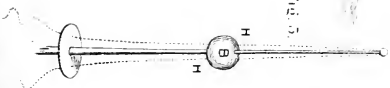


Fig. 5.

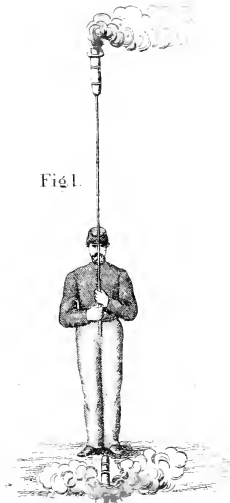






# PLATE X.

Fig. 1.



First Position-or "Ready"  
For Night Signals  
Torches.

Fig. 2.



First Position-or "Ready"  
For Night Signals  
Lanterns

Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.





## DAY SIGNALS BY HORIZONTAL MOTIONS.

Day signals can be made by horizontal motions, if there is the necessity. The application of the principle is similar to that already given, except in this, that the motions are made horizontally from side to side, and are to the right or left of some point of reference or fixed position instead of above or below it. Assume any one of the apparatus just illustrated to be projected horizontally from the side instead of from the top of any structure, and put in operation. The mode of signalling will be easily comprehended.

The First Position is with the Signal at the point of reference. The First Motion is to the outward extremity of the apparatus, if working from any structure or to the right of the signalist. The Second Motion is the opposite of the First Motion, whatever that may be. The Third Motion or half motion, is a perceptible movement from side to side of the point of Rest.

The illustrations of horizontal apparatus at Fig. 3, Plate IX, make clear the application.

Day signals may of course be made by any two differing motions. As by one vertical and one horizontal, or by any two indications. It is proposed to give here sufficient for practical use.

## NIGHT SIGNALS.

To be made with signal equipments. A flagman, standing, holds in his hand a staff twelve feet long, a flying torch, one and one-half inch in diameter, wicked, filled with turpentine, lighted and attached to the upper extremity of the signal staff by clamp-screws. Copper foot-torch, two inches in diameter, wicked, filled with turpentine, and lighted, is placed, lying horizontally, at the feet and in front of the flagman. (Plate X, Fig. 1.) The positions, orders, and motions for signalling at night, are identical with those used

in the day; the lighted foot-torch being the "point of reference" in relation to which all motions are made. Each torch is fitted with an extinguisher. At the conclusion of each message, the flying torch is extinguished. The foot-light or some other light is left burning in its place as long as signalling is continued, to the end that the communicating station may see to what point to direct their signals. A small fire or lantern is often used.

When, during the transmission of a message, the flying torch is lowered to the left and is there extinguished, it indicates that it is extinguished to be refilled, and as soon as filled and relighted, the message will be resumed without any further intimation. The torch must be refilled at the end of some word.

In night signalling, great care must be taken that the reference or foot-light is always and certainly within view of the communicating station. To ascertain this, placing the eye on the level and in the place of the foot-light, it must be noted whether the foot-light at the communicating station can be thence seen: if not, the foot-light must be raised or moved to a position certainly visible. This precaution should always be taken. The foot-light must be always in front of the flagman and directly beneath the flying torch, when that is in the first position.

It must be ascertained, by viewing the foot-light at the communicating station in the same way, from the ground at either extremity of the torch-swing, whether the torch also is in view to the communicating station at all parts of its course.

The torch should be refilled every fifteen minutes, and carefully trimmed after each message. When not in use, the wick should be covered with the extinguisher.

Lanterns are sometimes substituted for the foot-torch, especially on board of vessels where there is danger of fire.

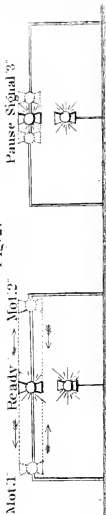
In this case, lanterns giving the most powerful light





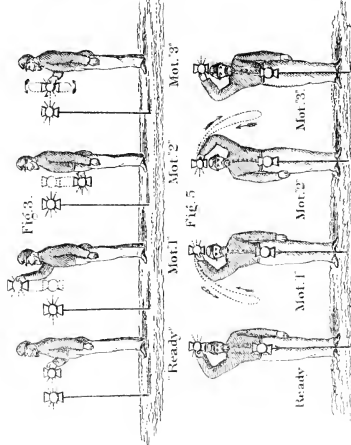
Fig. 1.

Fig. 2.

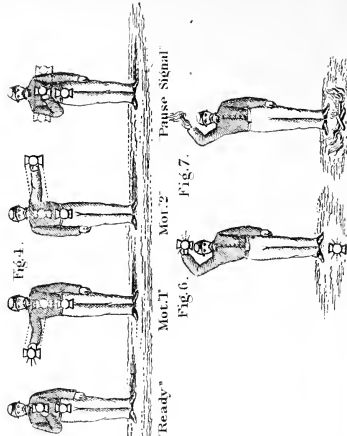


Night Signals by Vertical Motions.  
Lanterns held in the hand.

Night Signals Horizontal Motions.  
Lanterns held in the hand.



Night Signals Motions of Lanterns held in the hand.



Night Signals. Lantern or torch held in the hand.  
Fire or Lantern upon the ground.

should be selected. Lanterns with reflectors can be used, taking care that the lantern is so placed as to throw its light upon the communicating station. A lantern may be substituted for the flying torch, and attached to the extremity of the staff in its stead. This will be found difficult, however. The light is not nearly so brilliant or so distinct as that given by the torch.

In signalling at short distances, lanterns may be used instead of torches. One lantern being placed stationary as the foot-light, the other may be held directly above the head, in the hand as the first position. This lantern is then waved to the right, for "one" "1;" to the left, for "two" "2;" and lowered to the waist, for "three" "3," or pause-signal.

Signals can be made in this way, very conveniently for ship use, by placing one lantern upon the rail, and waving the other to its right or left to make any required signals, the general principles of the signals remaining the same. Signals made in this way are of convenient use in boats.

A convenient foot-light is often made, on shore, by lighting a small fire near the feet of the signalist. With a single lantern then held in the hand, or attached to a small staff, any message can be sent. Or if, for any cause, lanterns are not attainable, and fires can be kindled, a small fire may be used as a foot-light, while the signal motions are made with a brand from the fire, or a lighted pine-knot, or a piece of tarred rope, or with almost any combustible substance, capable of showing a flame and a light, held in the hand or attached to a staff, and properly waved to either side or to the front to make the required signal motions. (Plate XI, Figs. 6, 7.)

#### NIGHT SIGNALS BY VERTICAL MOTIONS.

Let there be one fixed light, as a brilliant lantern or lamp, fastened or hung to a standard. On shipboard, this must

be two or three feet above the rail of the vessel. This is the "light or point of reference." This reference light must be red, or of some color different from the moving light; or it must be distinguished from it by its intensity. Immediately behind or near the standard of the fixed light, is placed another standard or rod, twice the length of the first. To this rod is attached, by rings or slides, so that it may be moved steadily and easily up and down by the hand, another lantern or lamp. This is the moving or flying light, and the signals are made by its motions. The two lanterns being brought as nearly as possible together, are in the "first position." (Plate XI, Fig 1.)

To make the signal "one" "1," the flying lamp is moved rapidly to the top of its standard, and instantly returned to the first position.

To make the signal "two" "2," the flying light is slid rapidly to the bottom of the rod, and instantly returned to the first position.

To make "three" "3," or pause-signal, the flying light is moved quickly a very short distance above, and then an equal distance below the fixed light, returning to the first position—making what is called a half motion.

Thus to signal "C" "121," the flying light starting from the first position, would be carried to the top of the rod, then, without pause, to the foot of the rod, then quickly to the top of the rod again, thence to the first position.

To make "A" "22," the flying light, starting from first position, is moved rapidly to the foot of the rod, back to the first position, again to the foot of the rod, and then assumes the first position, thus making the second motion twice.

To make "N" "11," the flying light being in the first position, is moved rapidly to the top of the rod, back to the first position, again to the top of the rod, and then resumes the first position.

To make "M" "1221," the flying light, being in the first position, is moved rapidly to the top of the rod; then, without pause, to the foot of the rod; back to the first position; again to the foot of the rod; thence to the top of the rod; and then returns to the first position—that is, there are made one first motion followed by two second motions, followed by one first motion.

To make "33" or "clause-signal," there are made two half motions. After the manner of these examples are made whatever signals may be required.

### NIGHT SIGNALS BY HORIZONTAL MOTIONS.

The principle of this application is similar to that just described. The motions have the same value and are made in the same manner; with this difference only, that the flying light is moved horizontally and to the right and left of the fixed light, instead of above and below it.

The standard or fixed light being placed as before described, the flying light is arranged to traverse or slide freely on a small bar or rod placed horizontally behind it. The lights being brought as nearly as possible together, are in the first position. To make the signal "one" "1" the flying light is slid to the right a distance of three or four feet, and brought instantly back to the first position. To make the signal "two" "2," the flying light is slid rapidly to a distance of three or four feet to the left, and is brought instantly back to the first position. To make the signal "three" "3," the flying light describes a half motion, say a foot to the right, and then a foot to the left of the fixed light, returning to the first position; and thus for any number of "ones" and "twos," or for any combinations of "ones" and "twos." (Plate XI, Fig. 2.)

To increase the motion of the flying light, a handle may

be attached to the lantern by a swivel-joint. A movement of several feet is thus permitted.

Either apparatus here described, can be simply arranged anywhere. They have especial value on shipboard, for the reason that, from signals thus made, there can be no danger from fire. The brightest attainable lamps or lanterns should be used, and the two lights should be, either by their color or brilliancy, easily distinguishable. It is well that the fixed light should be either red, green, or some other marked color. They can be made with material almost always at hand.

Signals made on this plan, are capable of very simple application. Thus a red, or other colored light, can be hung in the rigging, or on the side of the ship or boat; while a lantern, held in the hand, is moved above and below it, making signals by vertical motions, as above described; or to the right and left of it, making signals by horizontal motions. (Plate XI, Figs. 3, 4.)

For signals at short ranges, there is then needed no kind of apparatus.

Of the many modes of night signalling, these described are, perhaps, sufficient for all ordinary uses.

The signals heretofore described have these advantages. They are capable of universal application. The mode of making them is very simple, and is very easily learned. They are distinct, and easily read. They are very plain. Every signal is, in reality, repeated "twice" each time it is shown. Thus the waves to the right or left, heretofore described, are read "one" or "two," whether the flag or torch is descending or ascending. It is necessary only to see that the signal is in motion somewhere on the right to read "one." In the same way, it is necessary only to note that the signal is waving on the left to read "two." A similar advantage is had in the plans for signals by vertical or horizontal motions.



The chances of seeing the signals are thus greatly increased. The signals are made with very simple apparatus. It is strong, portable, can be carried anywhere (on horse or on foot), is not liable to be damaged by an enemy's fire, or by rough handling, and is always available and ready for use. It can be used in almost any situation. The signals can be seen at very considerable distances. Avail can be had of many devices to make them visible. Thus the flags can contrast most strongly with the backgrounds against which they are visible. The motion of the signal is a valuable auxiliary of its visibility, this motion of the signal object or light producing a long and marked impression upon the retina of the eye. A thing in motion can always be seen and will attract attention, when a similar object resting produces no sensation. We recognize this fact instinctively when we wave a handkerchief, or light, to attract attention. It is never held still, for this purpose, and would be ineffective if it were.

The signals made with the ordinary equipments, say a staff twelve feet long, and a flag four feet square, or with the torches at night, are easily legible at a distance of eight miles at almost all times, except in cases of fog and rain. They are read at fifteen miles on days and nights ordinarily clear, and have been legible at twenty-five miles. Greater distances are reported; but it is questionable if, at those distances, there is reliability.

### TRANSIENT SIGNALS.

Transient signals comprise signals by flashes, signals by occultations, and signals by sound.

Signals by flashes and by occultations are identical in character and the principle by which they convey meaning.

## SIGNALS BY FLASHES.

Signals by flashes are not generally as distinct, or as easily read, as signals by motion. This is markedly the case when it is necessary to use the telescope. It is almost impossible to keep it at night upon any light which is not constant. When motions are used the lights are kept constantly in view, thus rendering it possible to fix the telescope upon them, and to accurately observe them.

Signals by flashes are made by flashes of different colors, as red for "one," and white for "two;" by flashes of different lengths, as a short flash for "one," and a long flash for "two;" or, by different numbers of flashes, as one quick flash for "one," and two quick flashes for "two." They may be used in many other ways, but these are sufficient for any ordinary use.

If a lantern (Plate XX, Fig. 4), with spring shades and spring handles, showing no light when put in position, shows a white flash when handle "one" is pressed down and then let go; a red flash when handle "two" is pressed and let go; and a green flash when handle "three" is pressed and let go; this lantern will suffice for all kinds of telegraphing by flashes, that will in ordinary use be required. Thus, attention being called, by a number of consecutive flashes, the signal lantern is allowed to stand dark. It is well to have another lantern standing close to it as a marker, to enable the telescope at the other station to be kept on the signal lantern at night.

To make "one" "1," press down handle "one" and let it go—it shows a white flash. To make "two" "2," press down handle "two," and let it go—it shows a red flash. For "three" "3," or a pause-signal, show a green flash by pressing down handle "three." Pauses between the signals may be indicated by time, as an interval being allowed to

elapsed after each complete signal, and a longer interval at the end of a word.

Thus, to signal "A," "22," flash "red red." To signal "K," "2121," flash "red white red white." To signal "S," "212," flash "red white red." To signal "W," "1121," flash "white white red white." To make "three," "3," end of a word, flash "green." To make "33," flash "green green." A dark interval after each signal marks the completion of the signal.

Or to work with flashes of one color:

To make "one" "1," "press down the handle for a second of time; it shows a short flash.

To make "two," "2," press down the handle with a longer pressure; it shows a long flash, "two" "2."

Let "three" "3" be a long dark interval.

Thus, to signal "E," "12," flash "short, long." To signal "M," "1221," flash "short, long, long, short." To signal "S," "212," flash "long, short, long." A short dark interval marks the completion of each letter: a longer dark interval, the end of each word.

Or a red flash, or any signal may be adopted as "three."

Another method:

To make "one" "1," press down the handle once; it shows a short flash.

To make "two," press down the handle twice; it shows two short flashes. To make "three," a dark interval.

Thus, to make "K," "2121," flash "twice, once, twice, once."

To make "L," "221," flash "twice, twice, once."

A short dark interval after each letter. A long dark interval after each word.

The flash-lantern can be used in various ways, which will suggest themselves. It is a convenient style of signalling when space is limited, as in a boat, or it is desired to show

signals only in one direction, as away from the enemy. To make extempore flash-signals with two common lanterns, one may be made red by a thin layer of red bunting, the other be left plain. Then either of them is shown as the signal "one," the other as the signal "two." The pause-signal is made by an interval of time, or by a wave of either. Or, a single lantern may be flashed once for "one," and twice for "two," by covering it with a bucket or hat, as with an extinguisher; and lifting the covering suddenly for each flash. One flash is then shown for "one," two flashes put together for "two," three flashes for the pause-signal. A good way to show either colored or plain lanterns, is to flash them by placing the lantern below the side of a boat, or top of a fence, and then raising them suddenly into sight, and lowering them suddenly to make each signal. Then, a wave of the lantern to make a pause-signal.

Signals by two elements, with colors, extend through such as are made with colored lights, those which may be signalled with composition fires of two different hues, and those by signal balls thrown into the air, as are the balls of a roman candle. Any flash or color of fire or light may indicate "one," any other, "two," or any kind of light or torch may be flashed different numbers of times. The pause is conventional.

#### SIGNALS BY OCCULTATIONS.

Day signals are styled "signals by occultations," when any object is brought suddenly into view, and then obscured or hidden at different times or for different lengths of time, for the purpose of making signals. The appearances of the object may be styled "flashes," and these distinguished by numbers, as one flash, two flashes, etc.; or by their length, as short, long, etc.

Suppose a window-shutter is so fitted as to be obscured by turning its edge to the observer, and is then flashed or

brought wholly into view, to make "one;" flashed twice, to make "two;" and so on. A long obscuration is "three" "3," pause-signal.

Or it is flashed into view a "short flash" to make "one;" and a "long flash" to make "two."

The principles of working and of reading are identical with those for signalling and reading other flashes, and do not require illustration.

The signals of Commander COLOMB, R. N., now used in the English navy, are flashes of a very brilliant light at night, and of a shutter-shaped signal by day.

Any object may be obscured in any way and flashed into sight to make signals.

#### SIGNALS BY SOUND.

Let any sound, as a tap on a light drum, stand for "one" "1;" and a different sound, as a tap on a bass drum, stand for "two" "2;" an interval of time to mark the end of a letter; a longer interval, the end of a word, or "three" "3."

Or let one tap of a drum stand for "one," two taps stand for "two;" intervals, for end of letters and words.

Or let a short blast of a steam trumpet stand for "one," a long blast stand for "two;" intervals, for end of letters and words.

Then to signal "P" "1212" with a drum, tap "light, bass, light, bass," or tap "once, twice, once, twice." Or to sound with a steam trumpet, sound "short, long, short, long." To signal "S" "212," tap "bass, light, bass," or tap "twice, once, twice," or sound "long, short, long;" and so for whatever signals.

At the end of each letter and word a pause of silence.

How any differing sounds, as low and high notes, short and long blasts, heavy and light tolls of great and small bells; or differing numbers of sounds, as one and two

strokes, one and two blasts, etc., may be used, will be comprehended from the preceding.

Signals may be made by bringing any object to a determined point of reference, as the top of a mast, the end of a yard, etc., and allowing it there to touch for different lengths of time, or a different number of times.

Thus a flag, starting three or four feet from the top of a mast, touches the top a second for "one" "1;" touches it two seconds for "two" "2." Intervals are allowed for pauses.

Or it touches it once for "1," and twice for "2," with intervals for pauses.

It may occur that it will be necessary to display signals at an elevation, as at the top of a common flag-staff.

The example at Plate VIII, Fig. 9, will illustrate the manner in which this may be done.

Signals by Two Elements may be reduced to the greatest simplicity for day uses. Practised signalists are not limited to the use of any apparatus. Thus, a handkerchief or hat held in the hand above the head, and waved to the right for "one" "1," to the left for "two" "2," and lowered to the waist for "three," is legible.

With a handkerchief attached to a walking-stick or a boat-flag, or regimental marker, or any light cloth on any staff or tied to a musket-barrel, messages may be sent a mile or two, or to even greater distances.

A man standing with his coat off, with his hands touching, upon his breast, for the first position, making a wave of his right arm for "one" "1;" a wave of his left arm for "two" "2;" dropping both arms to his sides for "three" "3;" and returning always to the first position after each motion, can thus transmit any message.

Or, having a fixed place to start from, a man walks a

pace or two to the left for "one," as many to the right for "two," and makes a sign, at a fixed point, to show the end of a word. Or, standing in view, a man touches any two things with a cane—as a drum and a barrel. He touches the drum for "one," the barrel for "two." He waves the cane to indicate the end of a word. Or men, placed in line three or four at a time, may be made to represent letters. The men with coats on may be "ones," those with coats off "twos."

Signals of two elements may be shown with any kind of semaphore.

Strips of any two kinds of colored cloth may be sent up on the halyards of a common flag-staff, to represent any letter-signal or numeral-signals; and these can be arranged by being shown one after the other for messages to be telegraphed in words; or for codes of message-signals by the rules before given.

Codes of signals, like the Naval Flag-code, may be thus prepared when masts or flag-staffs must be used; or, when it is desirable that a signal, as from an invested fort, should be hoisted and kept flying in order that friendly scouts, anywhere in sight, at any time of the day, may be able to see and read the message, or copy the signal in numbers for the information of the relieving forces. Simple codes may be arranged in this manner between ships and the shore.

To all these modes the rules before given for Sending, Receiving, Ordering, and Recording Signals, equally apply.

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With these varied examples of Day and Night Signals, and Signals by Sound, it seems that enough have been given to indicate signals for any emergency. With that thorough understanding of the principles it has been tried to impress, the means for communication will not fail to suggest themselves.

## COMPLICATING SIGNALS.

Codes of two elements may be complicated for Day or Night Signals.

Let all the positions and motions which can be made on the right side of any upright, or point of reference, be understood as "ones." All the positions and motions which can be made on the left side of the upright or point of reference, be understood as "twos."

When transmitting a message in letter-signals as here enumerated, and by this plan, no signal need ever twice appear in the same form, or as composed by the same motions.

For illustration, suppose that, in Fig. 4, Pl. IV, the arm in any of the positions a, b, c, it signals "one" "1," and in any of the positions e, f, g, it signals "two" "2." It is evident that in the signals "one, two, one," "1 2 1," the letter "C" can be exhibited in many different ways; yet all of similar meaning. Thus with the other letters of the alphabet.

So any color may be "one" "1," and all other colors "two" "2;" or any sound may be the "one," and all others "two;" and thus for infinite changes.

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The motions "one" and "two" may be reversed, if there is reason. Thus "one" or "1" may be the flag waved to the ground on the *left*, and then returned to the "first position." "Two" may be the flag waved to the ground on the *right*, and then returned to "first position." This method is preferred by some. The following Code—the Army Code of two elements, used during the War—is signalled after this manner:



## CODE OF TWO ELEMENTS.

(AN ARRANGEMENT OF TWO SYMBOLS.)

A—11	H—211	O—12	
B—1221	I—2	P—2121	
C—212	J—2211	Q—2122	V—2111
D—111	K—1212	R—122	W—2212
E—21	L—112	S—121	X—1211
F—1112	M—2112	T—1	Y—222
G—1122	N—22	U—221	Z—1111
&—2222    tion—2221    ing—1121			

## NUMERALS.

1—12221	4—11121	7—22111	
2—21112	5—11112	8—22221	
3—11211	6—21111	9—22122	0—11111

But in the GENERAL SERVICE CODE the “one” signal has been made on the right of the sending signalist, for the reason that, so made, it appears, when viewed through the telescope, on the left of the field of view of the receiver; and we are habituated by practice, to expect, in a sequence, the lesser numbers of a series to appear first and at our left of the viewed word or number. The signal “one” made on the right of the sending signalist, the signal “two” properly follows on his left.

We gain thus the aid of analogy to recognize and remember the numbers. The rule that, in Alphabetic Codes, the letter-signals should be each of a certain, and all of the same number of places, has not been followed. To make all the signal letters of equal length in a code of two elements, each letter-signal must be of five places. This is cumbersome.

## FIELD SIGNALS BY THREE ELEMENTS.

An advantage of signalling by three elements is, that the letters of the alphabet may be represented, using three elementary signals for each letter. It is thus possible always to determine when each letter has been fully made and is completed. With three symbols, there are twenty-seven arrangements of three places each.

### ALPHABET OF THREE ELEMENTS.

(AN ARRANGEMENT OF THREE SYMBOLS.)

A—112	F—122	K—323	P—313	U—233
B—121	G—123	L—231	Q—131	V—222
C—211	H—312	M—132	R—331	W—311
D—212	I—213	N—322	S—332	X—321
E—221	J—232	O—223	T—133	Y—111
				Z—113

### CODE SIGNALS.

3—End of a word.

33—End of a sentence.

333—End of a message.

22.22.22.3—Signal of assent: "I understand," or "Message is received and understood," or "I see your signals," or affirmative generally.

22.22.22.333—Cease signalling.

121.121.121—Repeat.

212121—Error.

211.211.211—Move a little to the right.

221.221.221—Move a little to the left.

Flag waved successively from side to side until attention is attracted—"Attention, look for signals from this point."

## NUMERALS.

1. 21112—Wait a moment.
2. 12221—Are you ready?
3. 22122—I am ready.
4. 22212—Use short pole and small flag.
5. 22221—Use long pole and large flag.
6. 12222—Work faster.
7. 11222—Did you understand?
8. 11112—Use white flag.
9. 11211—Use black flag.
0. 22222—Use red flag.

a—after.	b—before.	c—can.	h—have.
n—not	r—are.	t—the.	u—you.
ur—your.	w—word.	wi—with.	y—why.

## INSTRUCTIONS FOR USING THE CODE.

The whole number opposite each letter stands for that letter.

\* The numbers are made by the motions of a flag or signal to the right or left, or in front of a vertical position.

The Roman Letters may be used for Numerals.

The Rules before given for Receiving, Sending, Ordering, and Recording Signals apply to messages transmitted by this code. Each letter-signal is ordered by itself, and as condensedly as may be. Thus "A," "112," is called briskly "eleven two;" "H," "312," is called "thirty-one, two;" "N," "322," "three twenty-two;" and thus on.

In the same manner the receiver, seeing made signal "three three two," calls or writes "332," or "S." For "two two three," "223" or "O" is written; and thus for whatever combination.

## DAY SIGNALS—FLAGS IN MOTION.

There being furnished the Regulation Set of Signal Equipments, the flagman is equipped and stands as described for the first position.

There are ONE POSITION and THREE MOTIONS. (Plates VI, VII, XII, as for preceding code.)

The FIRST POSITION is with the flag held directly above the head of the flagman, the staff vertical, the butt of the staff at the waist. From this position:

To make the FIRST MOTION, or "one," "1," the flag is waved to the ground to the right, and instantly brought to the first position.

To make the SECOND MOTION, "two," "2," the flag is waved to the ground to the left, and instantly brought to the first position.

To make the THIRD MOTION, "three" "3," the flag is waved to the ground in front, and instantly brought to the first position.

The PAUSE OR SPACE SIGNAL is as given in the code—or an especial pause-signal may be concerted, as a wave of the flag around the head, etc.

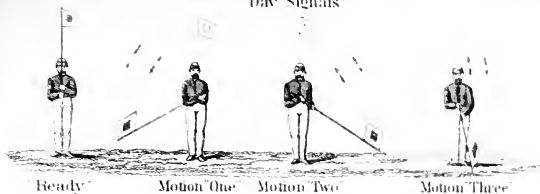
Each letter-number consists of three figures.

The motions of the flag for each figure follow each other without any pause between them until the letter-number is completed.

Thus to make "G," or "one, two, three" "123," the flag is waved, without pause, once to the right, once to the left, once to the front; and is then brought to the first position. To make "K," "three, two, three" "323," or "three twenty-three," the flag is waved, without pause, once to the front, once to the left, once to the front, and rests at the first position—that is, one "third motion," followed by one "second motion," followed by one "third motion." To make "B," "121" "one twenty-one," the flag is waved in "right, front,

# PLATE XII.

## Day Signals

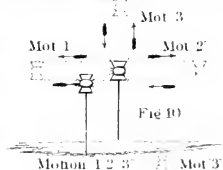
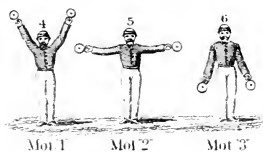
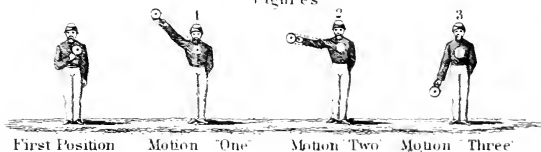


## Night Signals



## Day Signals with discs

### Figures





right," and rests at first position. To make "F," "122," the flag is waved "right, left, left," and rests at first position. To make "22," the flag is waved "left, left." To make "three thirty-three" "333," the flag is waved three times to the front, and then rests at the first position. At the end of each letter, the flag is held in the first position about two seconds, to show that the letter is finished.

A difficulty is experienced in the use of the flag for signals of three elements, from the fact that in the third motion, or motion "front," the edge of the flag is towards the observer, and the flag is not so perfectly visible. The flag may be improved for this purpose by attaching it to the staff as a pennant, with a swivel or string permitting motion. (Plate X, Fig. 7.) This, however, only lessens the difficulty. For common uses, any article, as a handkerchief or a hat held in the hand, or attached to a short staff, may be used as signals. A white ball, made by enwrapping some article with white cloth, is a convenient form and always visible. The manner of working follows the general plan above.

Day signals by three elements can, of course, be made with any three distinct motions to which meaning can be given.

As, having a fixed position as a point of reference, any visible object may be moved to the right of it for "1," to the left of it for "2," vertically above it for "3." The "pause" may be a half motion on either side the reference. Thus for any three motions, made in any direction relatively to any point of reference, the modes of signalling have been sufficiently illustrated. (Plate XII, Fig. 10.)

#### NIGHT SIGNALS.

Night Signals, made with the Regulation Signal Equipment, the foot and flying torches and twelve-foot signal staff, are very distinct and legible.

To make night signals, the signalman, equipped and standing in the first position, holds in his hand the signal staff with flying torch attached, filled and lighted. The copper foot-torch, filled and lighted, is placed at his feet and directly in front. (Plate X, XII.)

The instructions for working, the torch positions, motions, and pauses are precisely similar to those by which signals are made with the flag by day.

Especial directions for lighting, extinguishing, filling, and managing the torches are already given.

Signals made in this way are as brilliant as any that can be made with torches.

Lanterns may be substituted for torches on shipboard. A small fire kindled on the ground at the feet of the flagman, is a convenient foot-light. The motions may be then made relatively to this fire as the point of reference. The motions may be made with a torch, lantern, a brand from the fire, or with any light that can be had, having any fixed light for the point of reference.

Night signals may be made by any light which can be moved with any three distinct motions relatively to this point of reference. Thus the moving light may be moved horizontally on the right for "1," horizontally on the left for "2," vertically above it for "3." The "pause" may be as in the code, or a motion vertically below the reference point. (Plate XII, Figs. 10, 11.) The reference light must always be distinguished by brilliancy or by color.

So with two lanterns: one may be placed on the rail of a vessel or fixed on a standard. The first position is with the lights close together. First motion, "1," moving light is carried to the right and resumes position. Second motion, "2," moving light is carried to the left and resumes position. Third motion, "3," moving light is carried directly upwards; resumes first position. Pause-signal as in the





# PLATE XIII.

Figures.

1



"Ready"

2



Motion "1"

3



Motion "2"

4



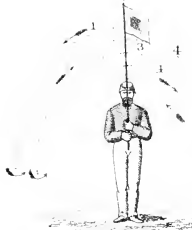
Motion "3"

5



Motion "4"

7



"One-four-three-four" - "1434"

6



Motion "five" - "5"

code; or a half motion or flourish of the moving light close to the fixed light. (See Plans, Plate XI, Fig. 5.)

### DAY SIGNALS—MOTIONS OF DISKS.

Homographic signals are, properly, whatever signals are made by the positions or motions of the body and limbs of a man.

Let there be a disk or disks of canvas, one foot or eighteen inches in diameter, fitted with a handle to be grasped by the hand.

There are ONE POSITION and THREE MOTIONS. (Plate XII, Figs. 1, 2, 3.)

To take the FIRST POSITION, or "ready," the signalman thus equipped, stands holding a disk in his right hand, at the height of the breast, the disk laid flat upon the breast.

The signalman so placed—

To make the FIRST MOTION, "one" "1," the right hand and disk are extended obliquely upward above the head at arm's length, and on the right side, and then returned to the first position.

To make the SECOND MOTION, "two" "2," the right hand and disk are extended horizontally at arm's length, and on the right side, then returned to the first position.

To make the THIRD MOTION, or "three" "3," the right hand and disk are extended obliquely downward, at arm's length, and on the right side, and then returned to the first position.

To make "PAUSE-SIGNAL," wave disk once around the head, then return to first position.

In making letter-numbers, the motions follow each other without pause. Thus, to make, "M," "one, three, two" "132," there is made one first motion, followed by one third motion, followed by one second motion. To make "K," "three, two, three" "323," there is one third motion, followed by one second motion, followed by one third motion.

To make "P," "313" "three thirteen," there is a third motion, a first motion, a third motion. To make "D," "212," a second motion, a first motion, a second motion.

A pause of time marks the interval between letters.

Space or pause signals mark ends of words and sentences,

It is well, when disks are used, to have a second disk held in the left hand, and at the height of and upon the breast. This gives a marked point of reference.

These signals are sometimes as follows: The shoulders are taken as a point of reference. Then all signals made above the shoulders are read for "ones," "1." All signals made horizontally at the height of the shoulder are read for "twos," "2." All signals made below the shoulder are read for "threes," "3."

Thus, if one disk is waved above the shoulder in the right hand, on the right side, it is read "one;" or if it is raised in the left hand, on the left side, it is read "one;" or if both disks are raised above the shoulders in both hands, on both sides, the signal is read "one." If the disk is extended horizontally at the height of the shoulder in the right hand, on the right side, the signal is read "two;" or if the disk is extended horizontally in the left hand, on the left side, the signal is read "two;" or if both disks are extended horizontally in both hands, on both sides, the signal is read "two."

Or if the disk is extended obliquely downward below the shoulder in either hand or on either side, or if both disks are extended obliquely downward in both hands on both sides, the signal is read "three."

In this way, the signal "one" is made (Pl. XII) whether the disk is raised as at Fig. 1, or Fig. 4, or Fig. 7. The signal "two," whether the disk is as at Fig. 2, or Fig. 5, or Fig. 8. The signal "three," whether the disks are as at Fig. 3, Fig. 6, or Fig. 9.

It is noted only to read "one," or "two," or "three," whether the signal is above, or at, or below the shoulder.

There are three signals for each single reading. Messages are sometimes transmitted in this way, the signals for the same letter continually varying.

It is interesting to note the very great variety of appearance that may be given, using this method, to the signals of the same message.

The letter "E," "123," for instance, can be, without other preconcert, signalled by twenty-seven different signals, each to an uninstructed observer unlike any other. So for any other letter in the alphabet.

The general forms for transmitting the message are as by the common rules.

So with colors, any two or three colors may be assumed to read, either shown, as "one;" any two other colors to read, either shown, as "two." Still other two to read, either shown, as "three."

The letter "E" signalled in colors may be represented by any of numerous arrangements. It will be seen how this plan might be used with flags.

So with sounds; the different sounds of a drum may be either of them read as "one," the sounds of a bell as "two," the sounds of a bugle as "three," and the signals thus complicated.

Rogers's Semaphoric Code of Signals is a code of three elements. It is skilfully applied for use on shipboard or in boats.

### NIGHT SIGNALS.

The Signaller is equipped with a red or colored lantern placed at the height of the waist, and a single lantern held in the hand.

The first position, or "ready," is with both lanterns close together at the height of the waist.

The Positions, Motions, and Pauses, with the Lanterns held in the hand are, for Night Signals, precisely similar to those described for the Disks for Day Signals. (See Plans, Plates XI and XII.)

Taking the shoulder as point of reference, night signals may be varied in the same manner as day signals—a white lantern being held in the hand in place of the disks; all signals above the height of the shoulder being counted “one,” all at the height of the shoulder “two,” all below the height of the shoulder “three.”

Night signals, remaining simple, are thus apparently complicated as in the cases described for the day.

#### SIGNALS BY FLASHES AND BY OCCULTATIONS.

Signals of three elements may be made with flashes of light of any three colors, as by the flashing signal-lantern before described.

To make “one” “1,” press the handle “one”—a white flash.

To make “two” “2,” press the handle “two”—a red flash.

To make “three” “3,” press the handle “three”—a green flash.

The flashes for each letter follow each other without pause. An interval of darkness is the space-signal.

Thus, to signal “G,” “123,” flash “white, red, green.”

To signal “M,” “132,” flash “white, green, red.”

To signal “O,” “223,” flash “red, red, green.”

To make “33,” flash “green, green.”

Or to signal with flashes of a single light, flash once for “one” “1;” twice for “two” “2;” three times for “three” “3.” Marked intervals of darkness to indicate spaces.

These signals may be made with common lanterns by flashing them from buckets or over the side of a boat, or over a fence. A plain lantern may be used to make "ones." A lantern covered with red bunting to make "twos." A lantern covered with green bunting to make "threes." Or a single lantern may be used if necessary, flashing it once for "ones;" twice for "twos;" three times for "threes;" a wave of the lantern for space-signal.

These modes are suggested for emergencies only. It is generally more convenient to use two lanterns, making the signals by motions. Many plans for pyrotechnic signals, in which are used white, red, and green colored fires, are signals of three elements. Codes of three elements may be at any time arranged for combinations of three fires flashed one after another on a pan, or burned one after another in cases, or thrown into the air, as balls from a Roman candle.

Day signals by occultations may be made after plans similar to those here given for night signals with a single light—by obscuring any object and flashing it suddenly into view.

#### SIGNALS BY SOUND.

Messages may be transmitted by any three different sounds, as by three different notes of a bugle, or as a stroke on a bell for "one" "1;" two strokes for "two" "2;" a tap on a drum for "three" "3:" or a tap on a light drum for "1;" two taps for "2;" a tap on a bass drum for "3:" or, more simply, one tap for "1," two taps for "2," three taps for "3." In this case the taps for each number, as "1," or "2," or "3," must be made very quickly and closely together. So that, for instance, "3" made by three close quick taps may sound very differently from "Y," "111," made by three taps slowly and distinctly given.

The general applications of Codes of Three Elements are numerous. The signals of this code can be made with any kind of semaphore. A man standing with his coat off and throwing out his right arm to his right for "one," his left arm to his left for "two," and his arm directly above his head for "three," can transmit any message. Or the arms may be waved with the motions described to be made by the flag.

Of course the three motions or positions heretofore described can be made with muskets, or branches, or flags, or any thing that can be held and moved by the hands, and can be distinctly seen; or any three things, as a cap, a coat, or a handkerchief, may be numbered as "one," or "two," or "three," and hoisted on halyards, being first properly arranged to indicate any letter or numeral; or three strips of different-colored cloth may be run up on halyards; or any three things, a barrel, a basket, and a pail, may be shown on a pole to indicate any letter or numeral; or three men may be stood together in view, one with his coat on for "one," one with his coat off for "two," one with his coat half off for "three;" each to throw up his arms as often as the number he stands for is called: any combinations may be made in this way.

Or three men standing side by side, and numbered "one," "two," "three;" one for each place to appear in the signals. A whole signal number being called, each takes that position which indicates the first, second, or third numerals of the signal number called. Thus, "one twenty-three" "123" being called, No. 1 takes the position which signals "one" "1," No. 2 takes the position "two" "2," No. 3 takes the position "three" "3;" and they so remain until the signal is seen and recognized, standing as in Plate XII, Figs. 1, 2, 3.

Signals of three elements, though not of such infinite application, or so constantly available as those of two elements,



are capable of many beautiful uses. A thorough knowledge of them should be gained, and every signalist ought to practise the code at times. Modes, always varying, may be multiplied by ingenuity.

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## FIELD SIGNALS BY FOUR ELEMENTS.

A code of four elements may be any arrangement of four symbols. The common code of army signals has been drawn as a code of four elements. This code is here given as an illustration. It has been superseded, in practice, by the "General Service Code."

The signal orders in a Code of Four Elements particularly describe each motion. Those long habituated to such an enumeration become attached to it and prefer it. The code thus arranged is here given.

## ALPHABET OF FOUR ELEMENTS FOR FLAGS IN MOTION.

(AN ARRANGEMENT OF FOUR SYMBOLS.)

A—11	H—231	O—14	
B—1423	I—2	P—2343	
C—234	J—2231	Q—2342	V—2311
D—111	K—1434	R—142	W—2234
E—23	L—114	S—143	X—1431
F—1114	M—2314	T—1	Y—222
G—1142	N—22	U—223	Z—1111
&—2222	ing—1143	tion—2223	

## CODE SIGNALS.

5—End of a word.

55—End of a sentence.

555—End of a message.

11.11.11.5—Signal of assent: "I understand," or "Message is received and understood," or "I see your signals," or affirmative generally.

11.11.11.555—Cease signalling.

234.234.234—Repeat.

143434—Error.

142.142.142—Move a little to the right.

114.114.114—Move a little to the left.

Flag waved successively from side to side until attention is attracted—"Attention, look for signals from this point."

## NUMERALS.

1—14223—Wait a moment.

2—23114—Are you ready?

3—11431—I am ready.

4—11143—Use short pole and small flag.

5—11114—Use long pole and large flag.

6—23111—Work faster.

7—22311—Did you understand?

8—22223—Use white flag.

9—22342—Use black flag.

0—11111—Use red flag.

## DAY SIGNALS—MOTIONS OF FLAGS.

The code is given as it has been used in the Army.

There are one position and five motions.

There being furnished the Regulation set of Signal Equipments—

To take the FIRST POSITION, "ready," the signalman stands with the signal staff in his hand, the flag vertically above the head.

So placed—

To make the FIRST MOTION, "one" "1," the flag and staff are waved to the ground to the left of the flagman; resume the first position.

To make the SECOND MOTION, "two" "2," the flag and staff are waved to the ground on the right of the flagman; resume the first position.

By the THIRD MOTION, "three" "3," is described the half-circle wave of the flag from the ground on the right to the ground on the left of the flagman. Flag resumes the first position.

By the FOURTH MOTION, "four" "4," is described the half-circle wave of the flag from the ground on the left to the ground on the right of the flagman. Flag resumes the first position.

FIFTH MOTION, "five" "5," "panse-signal" flag waved to the ground directly in front, then returned to first position.

To make "O," "14" "fourteen," commence a first motion to the ground on the left, followed by a fourth motion; resume the first position.

To make "B," "1423" "fourteen twenty-three," commence a first motion to the ground on the left, followed by a fourth motion, then a second motion, then a third motion; resume the first position.

To make "C," "234" "two thirty-four," commence a second motion, followed by a third motion, followed by a fourth motion; resume the first position.

To make "D," "111" "one eleven," make a first motion thrice.

Plate XIII, Figs. 1, 2, 3, 4, 5, 6, will clearly illustrate the motions.

The same movements of the flag made together indicate

each letter in the code of four as in the code of two elements.

For the general use of flag motions, as in the General Service or for common use, the enumeration by two elements, as for the General Service Code, is preferable.

#### DAY SIGNALS BY POSITIONS OF DISKS.

The code with this arrangement permits each letter to be represented by four positions of disks or other signals, as well as by the different motions of flags.

Thus, the signalman standing equipped, a disk held in the hand—

There are one position and four motions.

FIRST POSITION, disk at the height of and flat upon the breast.

FIRST MOTION, hand and disk obliquely above the head on the left side; return to first position.

SECOND MOTION, hand and disk obliquely down on the left side; return to first position.

THIRD MOTION, hand and disk obliquely above the head on the right side; return to first position.

FOURTH MOTION, hand and disk obliquely down on the right side; return to first position.

PAUSE or SPACE SIGNAL, "5," a wave of the disk.

To make "O," "14," make a first motion, then a fourth motion.

To make "B," "1423," make the first, fourth, second, and third motions.

To make "C," "234," make motions second, third, fourth.

For "D," "111," make the first motion thrice.

For "5," a wave of the disk.

These motions are so numbered as to correspond with the enumeration given the flag motions.

As a general rule in signalling, the lesser numbers ought to be made on the right of the signalist.

In this way, this code may be signalled by any four positions or motions.

### NIGHT SIGNALS.

Night signals are made, for this code, there being furnished the Regulation Signal Equipment, by motions of torches, a flying and a foot torch. Or by motions and positions of lanterns, the signalman being equipped with a reference lantern fixed at the waist, and a moving light, to be moved by the hand.

The Positions, Motions, Pauses, etc., of the signal lights at night, are similar for the same signals to those described for these signals with the flags or disks by day.

The Ordering and Recording of signals, the general rules for the management of apparatus, and for the sending and receiving of messages, are as in other modes of signalling.

This code affords an illustration of the mode by which any code of two elements may be commuted into one of four elements.

---

A code of four elements, in which each letter is represented by a signal of a determinate number of places, is as follows :

### ALPHABET OF FOUR ELEMENTS.

(AN ARRANGEMENT OF FOUR SYMBOLS.)

A—121	F—414	K—344	P—412	U—413
B—212	G—424	L—434	Q—213	V—314
C—131	H—242	M—321	R—214	W—234
D—313	I—323	N—312	S—341	X—432
E—141	J—232	O—421	T—143	Y—342
				Z—324

3—End of a word.

33—End of a sentence.

333—End of a message.

22.22.22.3—Signal of assent: "I understand," or "Message is received and understood," or "I see your signals," or affirmative generally.

22.22.22.333—Cease signalling.

121.121.121—Repeat.

212121—Error.

211.211.211—Move a little to the right.

221.221.221—Move a little to the left.

Disk waved successively from side to side until attention is attracted—"Attention, look for signals from this point."

a—after.	b—before.	c—can.	h—have.
n—not.	r—are.	t—the.	u—you.
ur—your.	w—word.	wi—with.	y—why.

A disk is used instead of a flag.

In this code each letter-signal is a signal of three places. The numerals may be represented by the Roman letters.

The signals for end of word, Clause, Error, Assent, etc., already given, are made with the same motions, the Disk held in the hand being used instead of the Flag, as in the General Service Code.

Especial combinations may be devised for these signals, if such are preferred for any reason.

These should be each of say two places, to clearly distinguish them from the letter combinations.

The General Rules for Sending, Receiving, Ordering, and Recording are as for the preceding Codes.

#### DAY SIGNALS.

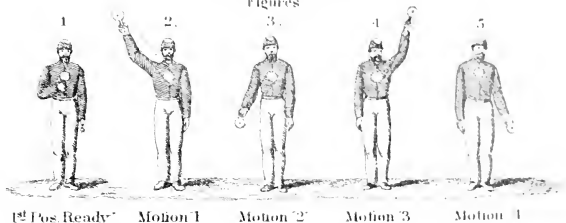
There are one position and four motions. (Plate XIV.)

FIRST POSITION: The signalman, standing equipped,

# PLATE XIV.

Day Signals with discs.

Figures



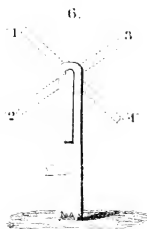
1st Pos. Ready

Motion 1

Motion 2

Motion 3

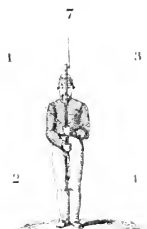
Motion 4



Semaphore Pos. 1234.



Semaphore Pos. 1234.  
on either Side



Positions of Musket



Common Article displayed as  
Signal





holds in his hands a disk at the height of and laid flat upon the breast.

To make the **FIRST MOTION**, or "one" "1," the right hand and disk are extended obliquely upward above the head at arm's length and on the right side, then returned to the first position.

To make the **SECOND MOTION**, or "two" "2," the right hand and disk are extended obliquely downward at arm's length and on the right side, then returned to the first position.

To make the **THIRD MOTION**, or "three" "3," the left hand and disk are extended obliquely upward at arm's length and on the left side, then returned to the first position.

To make the **FOURTH MOTION**, or "four" "4," the left hand and disk are extended obliquely downward at arm's length and on the left side, then returned to the first position.

To make pause or space signal, hand and disk waved around the head.

Thus to make "F," "414," the hand and disk are extended slowly obliquely downward on the left side, then returned to first position; then, without pause, extended slowly obliquely upward and on the right side, then returned to first position; then, without pause, again extended slowly obliquely downward and on the left side, then returned to and rests at first position;—that is, there is made one fourth motion, followed by one first motion, followed by one fourth motion.

To make "N," "312," there are made, without pause, one third motion, one first motion, one second motion.

To make "S," "341," there are one third motion, one fourth motion, one first motion.

To make "C," "131," there are one first, one third, one first.

To make pause-signal, "5," disk may be waved about the head.

To make clause-signal, "55," the disk may be waved twice about the head. In place of these signals (pause and clause) the "Code Signals," as given at page 127, are generally used.

In this way for whatever signals.

### NIGHT SIGNALS.

For night signals, the signalman equipped as before described, with reference light and moving light or lantern held in hand. The position "ready" is as illustrated at Plate XIV: a lantern held in the hand instead of a disk. The signals are made for the same numerals and with the same motions as those described for signals by day.

### GENERAL APPLICATIONS.

Following these plans, any code of four elements may be indicated by any object by day, or light by night, that can be put in any four positions, or made to describe any four motions relatively to any fixed object or light taken as a point of reference.

Thus the positions may be the four positions of the arm of a semaphore, as at Plate XIV, Fig. 6, the upright forming the point of reference, and the arm as at "1," being in the first position.

Or four positions made with a musket held in the hand, as at Plate XIV, Fig. 7, the musket held vertically being the position "ready."

Or the motions might be any thing moved above, below, to the right and to the left of any selected object.

Or of any light or torch so moved relatively to some distinguishable fixed light: a half motion making the space-signal. (Plate IV, Figs. 6, 7.)

Or signals of four elements may be made with the flashing signal-lanterns: as one white flash for "one," two white flashes for "two," one red flash for "three," two red flashes for "four;" a green flash may be "pause."

Or four different sounds may be used: one tap on a small drum for "one," two taps for "two," one tap on a large drum for "three," two taps for "four." Or one short blast of a horn for "one," two short blasts for "two," one long blast for "three," two long blasts for "four."

Or four different sorts of flags or strips of cloth, differing by colors or by shape, may be hoisted on halyards for any of the combinations of signals of this order. Or four different sorts of the most common things, as caps, coats, handkerchiefs, and boots, shown on halyards or on a staff in proper arrangements, will make any of the different signals. (Plate XIV, Fig. 9.)

Signals of four elements may be complicated, as has been illustrated in the case of signals of three elements, by causing several different signals to stand for the same element.

Thus with a semaphore, by which can be shown eight positions of the arms: Let any two positions stand for "one," two different and distinct positions for "two," two other distinct positions for "three," two other positions for "four." (Plate XIV, Fig. 8.)

Working thus, a code of four may seem to be a code of eight elements.

Signals of four elements are not so diversely available as those of two or three elements. The availability of signals diminishes in proportion as the elementary numbers or number of the order of the signals increases. Signals of four elements ought, however, to be carefully studied. They are capable of many interesting applications.

## FIELD SIGNALS BY FIVE ELEMENTS.

Alphabetic codes of five elements have this advantage: that the letter-signals of alphabets constructed by the arrangement of five symbols need require but two combined signals for any letter of the alphabet,—there being with five elements twenty-five arrangements of two places. This remembered, it is known with certainty that each pair of signals seen indicate a letter, and that it is completed.

A code of five elements might be as follows:

## ALPHABET OF FIVE ELEMENTS.

(AN ARRANGEMENT OF FIVE SYMBOLS.)

A—11	F—12	K—13	P—14	U & V—15
B—21	G—22	L—23	Q—24	W—25
C—31	H—32	M—33	R—34	X—35
D—41	I—42	N—43	S—44	Y—45
E—51	J—52	O—53	T—54	Z—55

---

The conventional signals, “error,” “assent,” “repeat,” etc., are made in the same manner as described for the General Service Code of two elements;—the Disk being waved instead of the Flag.

3—End of a word.

33—End of a sentence.

333—End of a message.

22.22.22.3—Signal of assent: “I understand,” or “Message is received and understood,” or “I see your signals,” or affirmative generally.

22.22.22.333—Cease signalling.

121.121.121—Repeat.

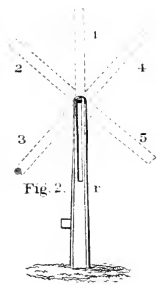
RT

# PLATE XV.

Day or Night Signals.  
Lanterns or Discs

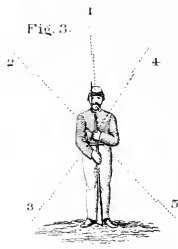


Positions 1.2.3.4.5.



Positions 1.2.3.4.5.

Musket Positions



Positions 1.2.3.4.5.

Day or Night Signals Discs or Lanterns.

Fig. 4.



Fig. 5.



Fig. 6.



Mot. one-five-15

Mot. three-four-34

Mot. two-two-22

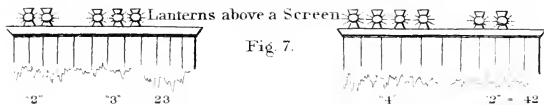
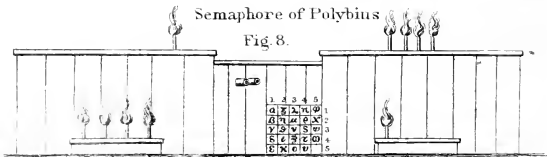


Fig. 7.

Semaphore of Polybius

Fig. 8.



1<sup>st</sup> Column

4<sup>th</sup> letter-14

212121—Error.

211.211.211—Move a little to the right.

221.221.221—Move a little to the left.

Disk waved successively from side to side until attention is attracted—"Attention, look for signals from this point."

#### ABBREVIATIONS.

a—after.	b—before.	c—can.	h—have.
n—not.	r—are.	t—the.	u—you.
ur—your.	w—word.	wi—with.	y—why.

The letters are symbolized, and are to be used as has been described for other alphabets.

The Roman letters are to be used for numerals.

The signals "error," "repeat," etc., may be as given, or they may be signified by arrangements of three places.

The General rules of Sending, Receiving, Ordering, and Reading signals are applied with this code.

#### DAY SIGNALS BY POSITIONS AND MOTIONS.

The signalman, standing equipped, holds in each hand a signal disk or other visible object.

There are ONE POSITION and FIVE MOTIONS. (Plate XV.)

To make the FIRST POSITION, or "ready," the signalman, standing equipped, and directly facing the point of communication, holds in each hand a signal disk at the height of and flat upon the breast.

The signalman, being equipped and placed—

To make the FIRST MOTION, "one" "1," the right hand and disk are extended slowly directly upward at arm's length and above the head, and then returned to the first position.

To make the SECOND MOTION, "two" "2," the right hand

and disk are extended slowly obliquely upward at arm's length and on the right side, and then returned to the first position.

To make the THIRD MOTION, "three" "3," the right hand and disk are extended slowly obliquely downward at arm's length and on the right side, and then returned to the first position.

To make the FOURTH MOTION, "four" "4," the left hand and disk are extended slowly obliquely upward at arm's length and on the left side, and then returned to the first position.

To make the FIFTH MOTION, "five" "5," the left hand and disk are extended slowly obliquely downward at arm's length and on the left side, and then returned to the first position. (Plate XV, Figs. 1, 4, 5, 6.)

PAUSE OR SPACE SIGNAL, "six" "6," a wave of the disk around the head.

Thus to signal "U," "one five" "15," the right hand and disk are extended directly above the head and then brought back to the first position, when, without pause, the left hand and disk are extended obliquely downward on the left and brought back to first position—that is, there is made one first motion, followed instantly by a fifth motion.

To signal "W," "two five" "25," the right hand and disk are extended obliquely upward on the right and brought back to first position; then, without pause, the left hand and disk are extended obliquely downward, and on the left, and brought back to first position;—that is, there is made one second motion, followed by one fifth motion.

To signal "Z," "five five" "55," the left hand and disk are twice extended obliquely downward on the left without pause, and each time brought back to first position.

To make "clause signal," "six six" "66," the right hand and disk are waved twice around the head.



To signal "Y," "four five" "45," make a fourth motion, followed by a fifth motion.

To make "U," "three two" "thirty-two" "32," make a third motion, followed by a second motion.

To make "two four five" "245," make a second motion, followed by a fourth motion, followed by a fifth motion. And thus for whatever combinations of this order.

### NIGHT SIGNALS.

The Signaller, equipped, has fixed at the waist a reference light, and holds a lantern in the right hand.

The position "ready," is with both lanterns close together at the height of the waist.

There are one position and five motions.

The Positions, Motions, and General Instructions for night signals are similar to those to be followed in making signals by day.

The distinctness of night signals, with lanterns, may be augmented by attaching a short rod to the moving lantern. The distance between the lights is thus increased in signaling.

Or signals of five elements may be made at night by showing five lights in different positions relatively to a central or fixed light. The central light, distinguished always by color or brilliancy from the signal lights, burns steadily. The other lights, to each of which a number is assigned, as one, two, three, etc., are screened dark; and each is shown only when, and in the order that, its number is called. The central light is flashed to make the pause or space signals.

Signals may be made with plain lights: showing one light for "one," two lights for "two," three lights for "three," four lights for "four," five lights for "five." A waving light for "pause-signal."

In this case, the first numeral of any letter-signal is shown

by the light placed on the right of the signalist; the second numeral by those placed on the left of the signalist.

Thus, to make "two three" "23," show, at the same moment, two lights, nearly together, for "two," and three lights at a little distance to the left of these for "three." (See Plate XV, Fig. 7.)

To signal "four four" "44," show four lights on the right and four on the left.

#### SIGNALS BY FLASHES AND OCCULTATIONS.

Signals may be made with flashes of a single light: as one flash for "one," two flashes for "two," three flashes for "three," four flashes for "four," five flashes for "five;" a long flash for "pause-signal," or "end of word."

Short intervals of time separate the component signals of a letter. Longer intervals mark the completion of each letter.

Thus, to make "H," "three two" "32," make three flashes; a pause of one second, then two flashes.

To make "N," "four three" "43," make four flashes; a pause of one second, then three flashes.

To make "B," "21," two flashes; a pause, one flash.

To make "33," three flashes; a pause, three flashes.

A longer pause, as of two or three seconds, is made after each letter or completed signal.

And on this plan Day Signals may be made by objects flashed suddenly into view and then obscured or hidden. The mechanical devices by which such effects may be produced are numerous.

Thus, a handkerchief, held in the hand, may be waved into view—as by suddenly throwing out and bringing back the arm, once for "one," twice for "two," three times for "three," and so on. Any message may be transmitted in this manner.

And on this plan a single light or a shutter may be flashed for Night or Day signals.

## SIGNALS BY SOUND.

Signals may be made by sounds: as the tolls of a bell, mots of a horn or bugle, or taps of a drum—sounding one tap for “one,” two taps for “two,” three taps for “three,” four taps for “four,” five taps for “five.”

Thus, to make “35,” three taps, a pause, five taps. To make “23,” two taps, a pause, three taps. To make “41,” four taps, a pause, one tap. Brief intervals of time mark the end of each letter-signal. Longer intervals indicate the completion of each word.

---

Signals may be made with any five motions or any five positions of any object relatively to any fixed point selected as a point of reference.

Field signals may be made by any five positions of the arm of a semaphore, as Plate XV, Fig. 2.

The position “ready,” is with the arm as at Fig. 2. The other positions are sufficiently indicated by the figure.

In signalling by five elements, the arm of the semaphore, or whatever object is used as the signal, may remain in each of the signal positions whatever length of time the signalist determines is necessary to enable it to be clearly seen.

Or field signals of five elements may be made with any five positions of any visible object; as a flag, a rod, or a gun, held in the hands: a musket may be used, some article being attached to make it more plainly visible. (Plate XV, Fig. 3.)

The position “ready,” the flag or gun held in the hands vertically, and directly in front of the signalman.

The first position, “one” “1,” flag or gun held vertically and directly above the head.

The second position, “two” “2,” musket inclined obliquely upward and to the right.

The third position, "three" "3," musket inclined obliquely downward and to the right.

The fourth position, "four" "4," musket inclined obliquely upward and to the left.

The fifth position, "five" "5," musket inclined obliquely downward and to the left.

Pause or space signal, "six" "6," a wave or flourish of the musket.

These positions are illustrated by the positions of the musket as seen in the plate.

In this way, to make the signal "15," take the first position and then the fifth position.

To make "32," take the third position and then the second position.

To make "33," make the third position twice.

Or five different things, as flags, or strips of cloth, or any five different distinguishable objects may be hoisted on hal-yards or otherwise brought into view, properly arranged, to make any signal of this order.

Or signals may be made by two men standing side by side, and numbered "one" and "two," who take each the proper position on hearing the letter-number called: No. 1 assuming the signal position for the first number-symbol; No. 2, the signal position for the second number-symbol; as Plate XV, Figs. 4, 5, 6.

### THE SYSTEM OF POLYBIUS.

The oldest system of signals of which there is record, was seemingly an alphabetic code of this order. Described in brief, it consisted in designating the twenty-four characters of the Greek alphabet by twenty-four arrangements of two places which can be made with any five elements or signals. (See table of references—Page 34; Plate XV, Fig. 8.)

This plan is minutely described by historians. By the

form of Polybius, the letters were arranged in five columns. Thus:

	1	2	3	4	5
1	A a	Z z	Λ k	Π p	Φ uv
2	B b	H g	M l	P q	X w
3	Γ c	Θ h	N m	Σ r	Ψ x
4	Δ d	I i	Ξ n	T s	Ω y
5	E e	K j	O o	Υ t	z

The smaller letters are to show the English alphabet arranged after this method.

Now to indicate in the first column the first letter, or the letter "A," "first first," "one one," or "11," is written.

To indicate in the third column the second letter, or the letter "M," "third second," or "three two," "32," is written.

To indicate in the third column the third letter, or "N," "third third," or "three three," "33," is written.

To signal letters, lights were shown above a fence or screen on the right or left of a known central position.

Thus, to make "A," or "11," one light was shown above the screen on the left, and one above the screen on the right of the fixed position.

To signal "M," or "three two" "32," three lights were shown on the left and two on the right of the fixed position.

To signal "N," "three three" "33," three lights were shown on the left and three on the right; and so for the signal-numbers of any letters.

The following description is extracted from Polybius, General History, Book I., Chap. X.:

"Take the alphabet and divide it into five parts, with five letters in each. In the last part, indeed, a letter will be wanting, but this is of no importance. Then let those who are to give and to receive the signals, write upon five tablets the five portions of the letters in their proper order, and concert together the following plan: That he, on one side, who is to *make* the signal, shall first raise two lighted torches, and hold them erect till they are answered by torches from the other side. This only serves to show that they are on both sides ready and prepared. That afterwards, he again who gives the signal shall raise first some torches upon the *left* hand, in order to make known to those upon the other side which of the tablets is to be inspected, —if the *first*, for example, a single torch; if the *second*, two; and so of the rest. That then he shall raise other torches also upon the right, to mark in the same manner to those who receive the signal, which of the letters upon the tablet is to be observed and written. When they have thus regulated their plan and taken their respective posts, it will be necessary, first, to have a dioptical instrument formed with two holes or tubes—one for discovering the right, and the other the left hand of the person who is to raise the torches on the opposite side. The tablets must be placed erect and in their proper order near the instrument; and upon the right and left there should be also a solid fence of about ten feet in length, and of the height of a man, that the torches, being raised along the top of those ramparts, may give a more certain light, and when they are dropped again, that they may also be concealed behind them.

\*       \*       \*       \*       \*       \*       \*

“When all things, then, are thus prepared, if it be intended, for example, to convey this notice, ‘that some of the soldiers, about a hundred in number, have gone over,’ it will be necessary, in the first place, to choose words for this purpose which contain the fewest letters. Thus, if it is said, ‘Cretans, a hundred have deserted,’ the same thing is expressed in less than half of the letters which compose the former sentence. These words, then, being first written down, are communicated by means of torches in the following manner. The first letter is K (*kappa*), which stands in the second division of the alphabet and upon the second tablet. The person, therefore, who makes the signal first, holds up two torches upon the left, to signify that it is the *second* tablet which is to be inspected; and afterwards five upon the right, to show that Kappa is the letter which he who receives the signal must observe and write—for Kappa stands fifth in the second division of the letters. Then again he holds up four torches upon the left, because P (*Ro*) is found in the fourth division; and two upon the right, to denote that it stands the second in that division. From hence the person who receives the signal writes Ro upon his tablets, and in the same manner the rest of the letters. By this method an account of every thing that happens may be conveyed with the most perfect accuracy.”

It is not uncommon to find this tabular arrangement of the alphabet applied to codes of recent origin. The form is not necessary to determine the signal-numbers of the letters, when it is borne in mind that the code is only an alphabetic code of five elements, and the letters are indicated by the numeral combinations prescribed by the usual rules.

The same results are then attained, one light being shown to signify “one,” two to signify “two,” three to signify “three,” four to make “four,” five to make “five.”

Thus to make "11," or "A," one light would be shown twice.

To make "three two" "32," or "M," three lights would be shown, followed by two lights.

To make "three three" "33," or "N," three lights would be shown, and then three lights. So for the alphabet.

Or if all the lights for each letter were to be shown at one time and together, then for "L," "two three" "23," two lights would be shown for "two," and three near them for "three." (Plate XV, Fig. 7.) No apparatus is needed.

For "N," "33," three lights would be shown—with three more near them.

The lights for the first numeral of the combination showing on the left of the sending signalist, those for the second numeral of the combination on his right.

Or signals of this kind may be made by positions, motions, flashes, sounds, as has been already described.

The study of the signals of this table is interesting. It will be referred to hereafter.

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## FIELD SIGNALS BY SIX ELEMENTS.

Signals of six elements are interesting, from the fact that this is the least number of elements, the combinations of which permit each letter of the alphabet and the numeral digits to be designated each by signals of two places. Each letter and number is signified thus by each pair of signals, and it can be judged when each signal is complete and perfect.

An alphabet of six elements might be as follows:



## ALPHABET OF SIX ELEMENTS.

(AN ARRANGEMENT OF SIX SYMBOLS.)

A—11	F—12	K—13	P—14	U—15	
B—21	G—22	L—23	Q—24	V—25	
C—31	H—32	M—33	R—34	W—35	
D—41	I—42	N—43	S—44	X—45	
E—51	J—52	O—53	T—54	Y—55	Z—16

## NUMERALS.

1—26	4—56	7—62	
2—36	5—66	8—63	0—65
3—46	6—61	9—64	

## CODE SIGNALS

The code signals below given are made with a disk, held in the hand, and used with the same positions and motions as those heretofore described for the same signals under the General Service Code.

3—End of a word.

33—End of a sentence.

333—End of a message.

22.22.22.3—Signal of assent: “I understand,” or “Message is received and understood,” or “I see your signals,” or affirmative generally.

22.22.22.333—Cease signalling.

121.121.121—Repeat.

212121—Error.

211.211.211—Move a little to the right.

221.221.221—Move a little to the left.

Disk waved successively from side to side until attention is attracted—“Attention, look for signals from this point.”

## INSTRUCTIONS FOR USING THE CODE.

The letters are symbolized and are to be read as has been described for other signals.

Each pair of signals indicates a completed letter or numeral.

The Roman characters may be used for numerals, instead of the combinations for numerals here given.

The working-signals "error," "affirmative," "repeat," etc., are made with the same motions as for the General Service Code; combinations of three places may be devised for these arbitrary signals.

The General rules for Sending, Receiving, Ordering, and Recording are applied to this code.

## DAY SIGNALS BY POSITIONS AND MOTIONS.

The signalman, standing equipped, holds in his hand a signal disk or other visible object.

There are ONE POSITION and SIX MOTIONS. (Plate XVI, Fig. 1.)

The FIRST POSITION or "ready," the signalman, standing equipped and directly facing the point of communication, holds in his hand a signal disk at the height of and flat upon the breast.

The signalman so equipped and placed—

To make the FIRST MOTION, "one" "1," the right hand and disk are extended slowly obliquely upward at arm's length above the head and on the right side, and then returned to the first position.

To make the SECOND MOTION, "two" "2," the right hand and disk are extended slowly horizontally outward at arm's length, and at the height of the shoulder, and then returned to the first position.

# PLATE XVI.

## Day & Night Signals

Fig. 1.

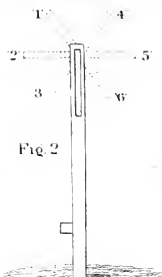


Lantern or Disc

1<sup>st</sup> Position & Motions

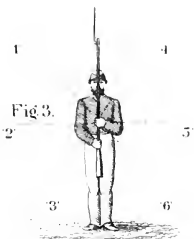
1. 2. 3. 4. 5. 6.

Fig. 2.



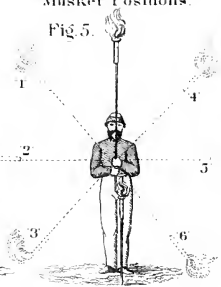
Positions 1. 2. 3. 4. 5. 6.

Fig. 3.



Musket Positions.

Fig. 5.



Night Signals. Torch & Stationary light.

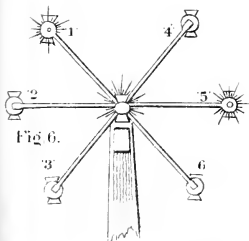
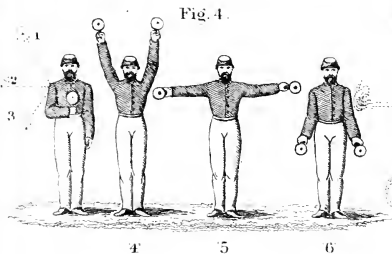


Fig. 6.

Night Signals. Flashes 1. 5. 15.

Fig. 7.



Fig. 8.

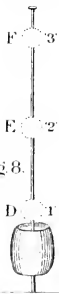
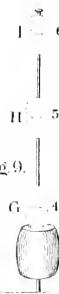


Fig. 9.





To make the THIRD MOTION, "three" "3," the right hand and disk are extended slowly obliquely downward at arm's length and on the right side, and then returned to the first position.

To make the FOURTH MOTION, "four" "4," the left hand and disk are extended slowly obliquely upward above the head at arm's length and on the left side, and then returned to the first position.

To make the FIFTH MOTION, "five" "5," the left hand and disk are extended slowly horizontally outward at arm's length at the height of the shoulder and on the left side, and then returned to the first position.

To make the SIXTH MOTION, "six" "6," the left hand and disk are extended slowly obliquely downward at arm's length and on the left side, and then returned to the first position.

PAUSE OR SPACE SIGNAL, "seven" "7," a wave of the right hand and disk around the head.

Thus, to signal "M," "three three" or "33," the right hand is extended obliquely downward at arm's length on the right side, and then brought back to the first position; and at once again extended in the same manner and again returned to the same position;—that is, there are made two third motions.

To signal "T," "five four" or "54," the left hand and disk are extended slowly horizontally at arm's length on the left side, and then brought back to the first position; when the same arm and disk are, without pause, extended obliquely upward at arm's length on the left side, and again brought back to the first position;—that is, there is made one fifth motion, followed by one fourth motion, "54."

To signal "K," "13" or "one three," the right hand and disk are extended obliquely upward on the right side at arm's length, and then returned to the first position; when, without pause, the same arm and disk are extended obliquely downward at arm's length on the same side, and again returned to the first position. Thus is made one first motion, followed by one third motion, "13."

To signal "W," "25" or "two five," the right hand and disk are extended horizontally at the height of the shoulder at arm's length and on the right side, and then brought back to the first position; when, without pause, the left hand and disk are extended horizontally at arm's length at the height of the shoulder and on the left side, and then brought back to the first position: a second motion, followed by a fifth motion.

To make "pause-signal," the right hand and disk may be waved twice around the head.

To signal "156," there is made one first motion, followed by one fifth motion, followed by one sixth motion.

To signal "1346," there is made one first motion, followed by one third motion, followed by one fourth motion, followed by one sixth motion.

And thus for any of the combinations or arrangements of six numerals.

---

Or field signals of six elements may be made with any six positions of any visible object, as with the arm of a semaphore, as in Plate XVI, Fig. 2,—the arm starting from a position of rest and moved into any position there given, being the signal for the number of that position. Thus, to make "14," "one four," the arm is moved first into position "one," and then into position "four;" at the end of the signal it returns to the position "rest."

To mark "11," the arm is moved from the position "rest"

to the position "one," returned to the position "rest," and again moved to the position "one."

The position "rest" is here the first position, and the movement of the arm to any numbered position is the motion known by the number of that position.

In this semaphore there are one position and six motions. The body and arm of a man may be used as a semaphore, and is one virtually for disk signals.

So signals of six elements may be made with any flag, or gun, or rod, or other object held in the six different positions—the positions being made one after the other in the proper order, to indicate the numeral elements.

---

Plate XVI, Fig. 3, represents a musket held in the hands; or some visible object, as a kerchief, to render it more distinctly visible, may be attached.

There are, for signals, the position "ready," and six signal positions.

The position "ready" is with the musket held vertically, directly above the head.

The signal positions are—

First position, "1," musket inclined upward and to the right.

Second position, "2," musket held horizontally and on the right side.

Third position, "3," musket inclined obliquely downward and to the right.

Fourth position, "4," musket inclined obliquely upward and to the left.

Fifth position, "5," musket held horizontally and on the left side.

Sixth position, "6," musket inclined obliquely downward and to the left.

"Pause," "error," etc., as for flag signals; musket re-

turns to first position after each completed signal number, or where the same numeral is repeated in any signal number, but not necessarily after each numeral of the signal number.

To signal "34," take the first signal position and then the fourth, then return to the position "ready."

To signal "45," take the fourth signal position and then the fifth signal position; return to position "ready."

To signal "1325," make the first signal position, then the third signal position, then the second signal position, then the fifth signal position; return to position "ready."

Where the positions of any signal to be made are some of them on the right and some on the left of the signalist, the musket is moved in the change from side to side over the head of the signalist. The signal arm or musket is allowed to remain in each signal position such time as the signalist deems necessary, that it may be fully recognized in that position. Its stops in each position must be marked.

#### NIGHT SIGNALS.

The signalman, equipped, has fixed at the waist a Reference Light, and holds a Lantern in his right hand.

The Position "ready," is with both lanterns close together at the height of the waist.

There are one Position and six Motions.

The Positions, Motions, and General Instructions for night signals are similar to those for making signals by day.

The reference light must be distinguished from the moving light by its brilliancy or color.

The mode of signalling has been already sufficiently described.

---

Or night signals of six elements may be made with torches, as of the signal equipment. (Plate XVI, Fig. 5.)



One torch is fixed stationary at a height of about four feet from the ground, and so prepared as to be distinguishable from the moving torch. The other can be moved from it in the six directions; returning to the stationary torch after each motion, as to a point of reference.

Thus there are one position and six motions. The position "ready," both torches close together, or one directly above the other. The motion "one" "1," obliquely upward, and to the right. The motion "two" "2," horizontally, and to the right. The motion "three" "3," obliquely downward, and to the right. The motion "four" "4," upward, and to the left. The motion "five" "5," horizontally, and to the left. The motion "six" "6," obliquely downward, and to the left.

Pause-signals, "attention," "repeat," etc., are made by different numbers of vertical motions.

"Attention,"—Torch moved vertically continually. "Assent,"—Torch moved vertically twice. "Repeat,"—Torch moved vertically three times.

#### SIGNALS BY FLASHES AND OCCULTATIONS.

Or signals of six elements can be made by six stationary white lights, arranged about a central light. (Plate XVI, Fig. 6.)

The central light burns steadily. The other lights are screened dark, and each is shown only when its number is to be made. The central light is flashed to make pause-signals. The central light must be distinguished from position lights, by its brilliancy or its color.

Thus, to make "one five" "15," there are flashed, first the position light "one," and then the position light "five." To make "three five" "35," there are flashed, first the position light "three," and then the position light "five." To make "24," flash light "two," then light "four." A pause of time is allowed after each completed signal.

The central light is flashed for any conventional signals.

This apparatus affords a good illustration of the numerous signals to be had from a few simple signals. With these six position lights and one central light, there can be made, using no light twice in any signal, one thousand nine hundred and fifty-six separate signals; or using repetition signals—that is, using the same lights twice or more times as may be required in the signals, but showing not more than six lights for any signal—there can be made fifty-five thousand nine hundred and eighty-six signals.

Code signals of six elements can be made with six flags: three small, a red, a white, and a blue; and three larger, a red, a white, a blue. Then the signal numerals, “one,” “two,” “three,” are represented by the small flags; the signal numerals, “four,” “five,” and “six,” by the larger flags.

The flags may be kept out of view (obscured), and each waved into sight as often as its number is called.

So signals may be made at night by any single light flashed “once” for “1,” “twice” for “2,” and so on. And by day, by any object obscured and flashed suddenly into view, an interval of time separating the signals of each letter-signal: a longer interval separating words.

#### SIGNALS BY SOUNDS.

So, too, signals may be made by sounds; by any different sounds, or by one sound repeated, as has been illustrated for other codes.

Field signals of six elements may be made with any six flags, or any six objects whatever, to designate the six symbols, and hoisted by pairs upon a halyard for any complete signal.

Or, in fine, signals of this order may be made by exhibit-

ing any six different motions, or positions, or sounds, or colors, or indications.

Or by exhibiting any one of these the proper number of times with proper intervals.

Enough examples are given for experiment.

Signals of six elements may be signified in such manner that any of the six symbols may be indicated at different times by different signals. For this purpose each symbol is signified by two or three different motions, positions, or other indications.

Thus, the signal positions "one," "two," "three," "four," "five," "six," may be represented with one arm, as already described; while it is understood that the signals "four," "five," "six," may be also in the same code represented—"four" by both arms directly upward; "five" by both arms horizontally outward at the height of the shoulder; "six" by both arms obliquely downward.

The letter-signals will so appear in many different guises.

A gentleman of Philadelphia, Mr. JAMES SWAIN, has elaborated codes of six elements with many beautiful and useful devices.

By his plans, any three positions, sounds, or motions, or indications, designated the symbols "one," "two," "three;" and for the symbols "four," "five," "six," these signals were duplicated.

Thus, Plate XVI, Fig. 4, the signal positions "one" "1," "two" "2," "three" "3," may be as given by the three positions of the arm at "one," "two," and "three;" while the fourth position, "4," is both arms held obliquely upward on both sides. The fifth position, "5," is both arms extended horizontally on both sides. The sixth position, "6," is both arms extended obliquely downward on both sides.

It may be understood that a single arm shown on either

side shall, if inclined upward, signal "one" "1;" if held horizontally, signal "two" "2;" if inclined downward, signal "three" "3."

So if "red," "white," and "green" are "one," "two," and "three," then "two reds," "two whites," and "two greens" may be "four," "five," and "six." And thus for other symbols.

To Mr. Swain belongs the credit of having first, in this country, directed attention to the practical uses of signal disks for the telegraphing of messages of any description; the enumeration of the letters of the alphabet after the Polybian method; and the advantages which are had by providing that each letter of the alphabet be indicated by the same and a certain number of figures. Practical plans for alphabetic homographic signals appear to have been devised by him at an early day.

The vocabularies and plans treated of by Mr. Swain evidence the study of years, and have received high commendation and the favorable reports of Military Boards in this country and in Europe. The devices perfected by this gentleman are worthy the careful study of every soldier. There will be, in active service, frequent occasions on which they may be used with advantage. The writer acknowledges his own indebtedness for many of the ideas elaborated in this volume to the suggestions of this skilful signalist.

Among Mr. Swain's plans is one of much convenience for using a single lantern, by which, by changes of color, any message is telegraphed. And one for a semaphore to be attached to a ship's mast and worked by balls, as illustrated at Plate XVI, Figs. 7, 8, 9, promises much utility.

To form an accurate idea of the study and labor bestowed on the subject of signalling by this gentleman, and the numerous successes which his ingenuity has achieved, a perusal of his elaborate papers is necessary. During the recent war of the rebellion, Mr. Swain's plans were tendered

by him for the free use of the Government, and some lessons in their use were given to classes of the Signal Corps. The difficulties which beset the classes at their organization prevented a thorough instruction.

---

Plate XVI, Figs. 7, 8, 9.—Let A B be an upright staff fitted to be attached to any mast or upright. Let C be a canvas tube or screen, in which are concealed two balls, so arranged as to slide freely upon the staff A B, for its length—these balls to be so fitted with halyards that one of them may be moved singly to any position upon the signal staff, or both of them to be moved together to any position upon the staff. The apparatus, as at Fig. 7, Plate XVI, is ready for use.

There are one position “ready,” and six signal positions.

The position “ready” is both balls concealed in the canvas tube, C.

Signal position “one” “1,” one ball at lower end of signal staff, as at D; signal position “two” “2,” one ball at centre of signal staff, as at E; signal position “three” “3,” ball at top of signal staff, as at F; signal position “four” “4,” both balls at bottom of signal staff, as at G; signal position “five” “5,” both balls at centre of signal staff, as at H; signal position “six” “6,” both balls at top of signal staff, as at I.

Signal of “attention,” one ball slid continually up and down upon the staff; signal of “assent,” ball moved twice from bottom to top of staff, and repeat; signal to “repeat,” ball moved three times from bottom to top of staff.

This semaphore has the advantage that the signals are visible from any direction.

## FIELD SIGNALS BY SEVEN ELEMENTS.

An alphabet of seven elements would be as follows:

## ALPHABET OF SEVEN ELEMENTS.

(AN ARRANGEMENT OF SEVEN SYMBOLS.)

A—21	F—32	K—43	P—54	U—71	
B—23	G—34	L—45	Q—61	V—72	
C—24	H—35	M—51	R—62	W—73	
D—25	I—41	N—52	S—63	X—74	
E—31	J—42	O—53	T—64	Y—75	Z—76

## NUMERALS.

1—17	4—47	7—56	
2—27	5—57	8—66	0—11
3—37	6—67	9—77	

The Roman characters for notation may be used instead of the combinations of numerals.

Each letter signal must be indicated by two numerals.

The conventional signals for “end of word,” “error,” etc., may be motions, as for the General Service Code, or they may be designated by especial combinations. These need be of two places only.

Messages are transmitted under the General Rules for Sending, Receiving, etc.

## DAY AND NIGHT SIGNALS.

The seven elements may be signified for day or night signals.

The signaller standing and equipped as described for other signals by

One position and seven motions.

As first position, disk at the height of the breast.

Motions—hand and disk returning to first position after each motion. First: hand and disk directly above the head. Second: hand and disk obliquely upward and to the right. Third: hand and disk horizontally outward and to the right. Fourth: hand and disk obliquely downward and to the right. Fifth: hand and disk obliquely upward and to the left. Sixth: hand and disk horizontally outward and to the left. Seventh: hand and disk obliquely downward and to the left.

Code signals: by waves of the disk.

Or by any seven different positions relative to a fixed position, as of a semaphore or homograph.

Or by any seven different flags, to be in view on hal-yards or masts.

Or by any seven different lights, colors, sounds, or visible things or indications.

Or by any seven different combinations of any indications which can be used as signals.

Field signals by seven elements are rarely used. The example is here given for the purpose of such practice as may enable the student to acquaint himself practically with signals formed upon this plan, as with others given.

The general plans for the use, should it become at any time desirable, will be sufficiently understood from preceding instructions.

## FIELD SIGNALS BY EIGHT ELEMENTS.

An alphabet of eight elements might be as follows :

## ALPHABET OF EIGHT ELEMENTS.

(AN ARRANGEMENT OF EIGHT SYMBOLS.)

A—12	F—24	K—43	P—62	U—74	
B—13	G—32	L—44	Q—63	V—82	
C—14	H—33	M—52	R—64	W—83	
D—22	I—34	N—53	S—72	X—84	
E—23	J—42	O—54	T—73	Y—85	Z—86

## NUMERALS.

1—18	4—48	7—78	
2—28	5—58	8—87	0—11
3—38	6—68	9—88	

The Roman characters may be used instead of the combinations for the numeral digits.

Each letter-number consists of two numeral symbols.

The conventional signals for “end of word,” “error,” etc., may be motions, as for the General Service Code, or especial combinations. These need be of two places only.

Messages are transmitted under the General Rules.

## DAY AND NIGHT SIGNALS.

The eight elements may be signified for day or night signals.

The signalman standing and equipped as before described, by

One position and eight motions.

First position—disks at the height of the breast.



Motions—hands and disks returning to first position after each motion. First: hand and disk directly above the head. Second: hand and disk obliquely upward and to the right. Third: hand and disk horizontally outward and to the right. Fourth: hand and disk obliquely downward and to the right. Fifth: hand and disk directly downward in front. Sixth: hand and disk obliquely upward and to the left. Seventh: hand and disk horizontally outward and to the left. Eighth: hand and disk obliquely downward and to the left.

Code signals by waves of the disk.

Or the eight elements may be signified by any eight different positions relative to a fixed position.

Or by any eight different flags.

Or by any eight different lights, colors, sounds, things, or indications.

Or by any eight different combinations of indications which can be used as signals.

If we have any four things or indications which can be increased or duplicated—then one, two, three, and four may be indicated, each by one of those things—and five, six, seven, and eight by the increased development of the same things. Thus, if there are four different short notes, these may be one, two, three, and four; the same different notes, long, may be five, six, seven, eight.

Or there may be four single notes for the first four symbols, and the same four notes doubled for the second four symbols.

Or four different *small* flags for one, two, three, four; four similar *large* flags for five, six, seven, eight. Thus for whatever indications.

Field signals of eight elements are rarely used, and, as in the preceding case, the example is here given for practice only.

## FIELD SIGNALS BY NINE ELEMENTS.

An alphabet of nine elements would be as follows :

## ALPHABET OF NINE ELEMENTS.

(AN ARRANGEMENT OF NINE SYMBOLS.)

A—22	F—34	K—53	P—72	U—84
B—23	G—42	L—54	Q—73	V—92
C—24	H—43	M—62	R—74	W—93
D—32	I—44	N—63	S—82	X—94
E—33	J—52	O—64	T—83	Y—95
				Z—96.

## NUMERALS.

1—1	4—4	7—7	
2—2	5—5	8—8	0—11
3—3	6—6	9—9	

The Roman characters may be used for the numerals.

Each letter-number consists of two numeral symbols. The conventional signals, “end of word,” etc., may be motions as for General Service Code, or especial combinations. These may be of two places.

Messages are transmitted under the General Rules.

## DAY AND NIGHT SIGNALS.

The nine elements may be signified for day or night signals.

The signalman standing and equipped as before described, by

One position and nine motions.

First position—hand and disk at height of the breast.

Motions—hands and disks returning to first position after each motion:

First: hand and disk obliquely upward to the right. Second: hand and disk horizontally outward and to the right. Third: hand and disk obliquely downward and to the right. Fourth: hand and disk obliquely upward and to the left. Fifth: hand and disk horizontally outward and to the left. Sixth: hand and disk obliquely downward and to the left. Seventh: both hands and disks obliquely upward on both sides. Eighth: both hands and disks horizontally outward on both sides. Ninth: both hands and disks obliquely downward on both sides.

Code signals as before given.

Or the nine elements may be signified by any nine different positions.

Or by any nine different flags.

Or by any nine lights, colors, sounds, things, or indications.

If there are three signals which can be duplicated and triplicated, or otherwise thrice increased, then these may signify each one, two, three; and when duplicated, four, five, and six; and when triplicated, seven, eight, and nine.

Thus if there are three notes, these singly may be one, or two, or three; doubled, they are four, or five, or six; tripled, they are seven, or eight, or nine.

So with three sets of three each of signal flags of the same color, but of three different sizes or shapes.

One set of such flags may be one, two, three; a second set may be four, five, six. A third set may be seven, eight, and nine.

The same modes may be extended to any signs, motions, or positions.

Signals of nine elements are not of general use, and, as in the preceding instances, the example is given for practical illustration only.

## FIELD SIGNALS BY TEN ELEMENTS.

Signals of this order admit the use of all the numerals to represent either the letters of the alphabet, or to be arranged for codes of messages.

An alphabetic code of ten elements might be as follows:

## ALPHABET OF TEN ELEMENTS.

(AN ARRANGEMENT OF TEN SYMBOLS.)

A—32	F—44	K—63	P—82	U—94
B—33	G—52	L—64	Q—83	V—10
C—34	H—53	M—72	R—84	W—20
D—42	I—54	N—73	S—92	X—30
E—43	J—62	O—74	T—93	Y—40
				Z—50

## NUMERALS.

1—1	4—4	7—7	
2—2	5—5	8—8	0—0
3—3	6—6	9—9	

The rules, instructions, and illustrations given for other codes sufficiently describe the plans for practice with this.

## THE GENERAL SERVICE HOMOGRAPHIC CODE.

The General Service Homographic Code is one of ten elements. A code with this number of elements is furnished, for the reason that it will readily permit the application of the signals to the signal-books already compiled for the use of the naval forces; as, for instance, the Naval Signal Code, and the Code of Boat Signals.



# PLATE XVII.



Ready



1



2



3



4



5



6



7



8



9



0

There are, for Signals, ONE POSITION and TEN MOTIONS. (Plate XVII.)

The signalman is equipped as follows: He holds in each hand a disk of canvas, one foot or eighteen inches in diameter, stretched upon a circle of strong wire, and having attached a handle for convenience of management. This handle may be of size only sufficient to be grasped by the hand; or it may be, to give greater distinctness to the signals, say two feet in length. The signalman being thus equipped, to take the first position, or "ready," stands holding a disk in each hand, with the disks held together and at the height of the breast.

To make the FIRST MOTION, or "one" "1," the right hand and disk are extended obliquely upward above the head, at arm's length, and on the right side, then returned to the first position.

To make the SECOND MOTION, or "two" "2," the right hand and disk are extended horizontally, and at arm's length, on the right side, then returned to the first position.

To make the THIRD MOTION, or "three" "3," the right hand and disk are extended obliquely downward, at arm's length, and on the right side, then returned to the first position.

To make the FOURTH MOTION, or "four" "4," the left hand and disk are extended obliquely upward, at arm's length, and on the left side, then returned to the first position.

To make the FIFTH MOTION, or "five" "5," the left hand and disk are extended horizontally, at arm's length, and on the left side, then returned to the first position.

To make the SIXTH MOTION, or "six" "6," the left hand and disk are extended obliquely downward, at arm's length, and on the left side, then returned to the first position.

To make the SEVENTH MOTION, or "seven" "7," both hands and disks are extended obliquely upward above the head, at arm's length on both sides, then returned to the first position.

To make the EIGHTH MOTION, or "eight" "8," both hands and disks are extended horizontally, at arm's length, on both sides, then returned to the first position.

To make the NINTH MOTION, or "nine" "9," both hands and disks are extended obliquely downward, at arm's length, on both sides, then returned to the first position.

To make the TENTH MOTION, or "the cipher" "0," both hands and disks are held together, at arm's length, above the head, one disk covering the other, then returned to the first position.

The GENERAL SERVICE HOMOGRAPHIC ALPHABET is as follows:

A—11	F—12	K—13	P—14	U—15
B—21	G—22	L—23	Q—24	V—16
C—31	H—32	M—33	R—34	W—25
D—41	I—42	N—43	S—44	X—35
E—51	J—52	O—53	T—54	Y—45
				Z—55

#### NUMERALS.

1—1	4—4	7—7
2—2	5—5	8—8
3—3	6—6	9—9
		0—0



## CODE SIGNALS.

The following code signals are made as described for the General Service Code of two elements—a Disk being waved instead of a Flag :

3—End of a word.

33—End of a sentence.

333—End of a message.

22.22.22.3—Signal of assent: “I understand,” or “Message is received and understood,” or “I see your signals,” or affirmative generally.

22.22.22.333—Cease signalling.

121.121.121—Repeat.

212121—Error.

211.211.211—Move a little to the right.

221.221.221—Move a little to the left.

Disk waved successively from side to side until attention is attracted—“Attention, look for signals from this point.”

## ABBREVIATIONS.

a—after	b—before.	c—can.	h—have.
n—not.	r—are.	t—the.	u—you.
ur—your.	w—word.	wi—with.	y—why.

The enumeration of this alphabet is nearly similar to that of six elements, made after the Polybian method, and adopted by Mr. SWAIN.

The signals given in the code for the numeral digits are to be used when numbers, not occurring in messages, are to be signalled, as occurs in Naval Signal Codes, etc.

Numbers given in any message are either spelled at length, or the Roman letters are used.

If it happens that the signals for numbers are to be used in a message, a wave of the disk must be made at the be-

ginning and at the end of the completed number, to clearly distinguish the numeral signals from the letter signals.

In the alphabet, there are used six only of the signal motions previously described, for the reason that it is not necessary to use more; and these six can be made by a single motion of a single arm for each signal.

Two motions, neither more nor less, are required to make each letter.

Each numeral character is indicated by a single motion. Thus to make 293, but three motions are needed.

Messages are transmitted under the General Rules for Sending, Receiving, Ordering, and Recording signals.

For illustration: To communicate, by such signals, the word "ship," the signalman, being in first position with the disk flat on his breast, to make the letter "S," "four four" "44," the left hand and disk are extended slowly obliquely upward, at arm's length, and on the left side, and returned to the first position, thus making the signal "four" "4," and are again extended, without pause, in the same manner, and again returned to the first position, thus making the signal "four" "4," again. There is thus made the signal "four four" "44," or the letter given. A pause of two seconds.

To make the letter "H," or "three two" "32," the right hand and disk are extended slowly obliquely downward, at arm's length, and on the right side, then returned to the first position; thus making the signal "three" "3," then, without pause, the right hand and disk are extended slowly horizontally, at arm's length, and on the right side, then returned to the first position, thus making the signal "two" "2." Pause. There has thus been made the signal "three two" "32," the letter given. A pause.

To make the letter "I," or "four two" "42," the left hand and disk are extended slowly obliquely upward, at arm's length, on the left side, then returned to the first position,

thus making the signal "four" or "4;" then without pause, the right hand and disk are extended slowly horizontally, at arm's length, and on the right side, then returned to the first position, making thus the signal "four two" "42," or the letter given. A pause.

To signal the letter "P," or "one four" "14," the right hand and disk are extended slowly obliquely upward, at arm's length, and on the right side, then returned to the first position, thus making the signal "one" "1;" then, without pause, the left arm and disk are extended slowly obliquely upward, at arm's length, and on the left side, then returned to the first position, thus making the signal "four" "4." There is made thus the signal "one four" "14," or the letter given. A pause.

We have signalled thus, letter by letter, the word "Ship." To indicate that the word is completed, the "end of word" signal, code signal "3," is made.

The positions of the disks just described resemble those proposed for a military code, attempted many years ago in Europe, and illustrated in 1805 by Mr. SPENCER, its inventor.

### HOMOGRAPHIC NIGHT SIGNALS.

The signalman is equipped for Homographic Night Signals, by having fastened at the height of his waist, a lantern as a reference light, and holding a lantern in his hand. The lantern at the waist should be red, or easily distinguishable from the moving lantern by its color or by its brilliancy. The motions and positions, indicating the figures and numbers, are made in precisely the same way, and have precisely the same meanings as those already described for Homographic Day Signals. In like manner all the rules and practices given for day signals apply equally at night.

For alphabetic signals it will be necessary to use only one red light fastened at the waist, and one white light to be

held in either hand, as the signal may require. It will be noticed, that no signal requiring the display of three lights is used in the alphabetic code.

In code signals, where any of the numeral digits may be required to be signalled to indicate the higher numbers, the signalman must be equipped with three lights. (Plate X, Fig. 2.)

With a little practice, night signals of this kind can be read as rapidly as those used for the day.

With these, as with all other signals, care should be taken that the signalman exactly faces the point to which the message is sent.

#### RETURNING OR REPEATING HOMOGRAPHIC SIGNALS.

In using signals of this character, when there is any difficulty in the reading, as may be from the heavy rolling of a ship or other causes, each signal made must be kept in view—the disk held at arm's length, and not returned to the first position—until the signal is seen to be repeated by the signalman at the receiving station. When the hand and disk of the signalman at the sending station return to the first position, the hand and disk of the signalman at the receiving station will, in the same manner, resume the first position. This plan, which causes no delay in the working, may be resorted to at any time to render absolutely certain that a message is correctly received at the receiving station. Each signal made by one party being thus returned by the other, before the next signal is made, there can be no question as to its accuracy.

The act of Returning Signals, to show that they have been recognized, differs from Repeating Signals to be read by a third station. In the former instance, the signalman returning signals, faces toward the sending station, from which they are received. In the latter instance, the signalman faces

away from the sending station, and toward the third station.

In case a signal is for any reason to be repeated by the receiving station, the hand and disk of the signalman, at the sending station, are held extended in each motion, until the hand and disk of the signalman at the receiving station are seen to be extended in the same manner, and to make the same signal toward the next station.

No station resumes the first position until it has seen the signal position correctly taken by the station next to it in the succession.

The pauses between the letters serve to indicate the separation of the letter-signals. The waves of the disk at the end of each word indicate the completion of the word, and both pauses and pause-signals must be returned or repeated at the receiving station, precisely as they are made at the sending station.

#### APPLICATION TO SIGNAL BOOKS.

When messages are not to be transmitted verbatim, but are to be indicated by certain different numbers, each number standing for a complete message, as is the case with codes of naval signals, or boat codes, the different numerals are exhibited by making the different motions indicating the figures that make up the number in their proper order; thus, to make the number 1954, which may stand for any sentence, there are made a first motion, "one" "1," followed by a ninth motion, "nine" "9," followed by a fifth motion, "five" "5," followed by a fourth motion, "four" "4,"—signalling thus, 1954. Pause-signal, to indicate number complete.

To make 163, there would be a first motion, "one" "1," followed by a sixth motion, "six" "6," followed by a third motion, "three" "3,"—making thus the number 163.

To make 104, there would be a first motion, "one" "1,"

followed by a tenth motion, "naught" "0," followed by a fourth motion, "four" "4"—"104;" and so for any number, whether it consists of a greater or less number of figures.

As in the case of letter-signals, these numbers may be required to be signalled back, figure by figure, from the receiving station, when accuracy must be rendered absolutely certain; or when, for any reason, it is desirable they should be thus returned. When circumstances will permit, and there are conveniences for working, it is desirable to make this style of repetition the usage.

Or it may be necessary to repeat code signals from station to station, in the mode already described.

#### ORDERS IN HOMOGRAPHIC SIGNALS.

When homographic signals are made by the signalman, each letter-number is called off briskly as an order, the signalman making promptly, on hearing the order, those motions which indicate the figures of the numbers called. Thus, to make "A," "eleven" is ordered, and two "ones" are promptly made. To make "H," "thirty-two" is ordered, and the motions "three" "3," "two" "2," are promptly made. To make "N," "forty-three" is ordered, and the motions "four" "4," "three" "3," are promptly made. And thus for any letters of the alphabet.

The pause-signal is ordered by calling "Code three." Close of sentence is ordered by the call "Code thirty-three." End of message is ordered by calling "Code three thirty-three." Four pause-signals in succession are, "Cease signalling."

The "error-signal," signal for "assent," "repeat," etc., are made by waving the disk from side to side, by the same motions as in flag signals, and are ordered by the same command, preceded, in every instance, by the word "Code."

With practised signalmen, the letter, word, or clause of a sentence to be transmitted may be given without the orders for the signal-numbers.

### RECORDING HOMOGRAPHIC SIGNALS.

When homographic signals are used, each number as seen signalled may be taken down in numbers on paper, and afterwards read by reference to the alphabet. The numbers of signals seen may, in particular instances, be written successively without stops or distances between them, and the figures of this record be pointed off by twos when it is to be translated. It is known, when they are pointed off, that each pair of figures must stand for a letter.

In this homographic code, as in all codes in which each letter is indicated by a certain and always the same number of symbols, it need not cause confusion if the two signals which together indicate a letter are made irregularly as to time, for if any one signal is seen, the receiver is aware that this is a part only of a letter, and he waits, be the interval longer or shorter, until he has seen the *second* signal of that letter before he records the letter as completed.

A message to be signalled, may be written in numbers without giving to the signalist any clue to the meaning.

Of course the letters of the alphabet may be indicated by any numbers at the will of the commander, and messages be thus transmitted, of which none but the corresponding commander would know the meaning. Thus "A," instead of being indicated by "eleven" "11," may be indicated by "twenty-nine" "29;" "D," instead of "twenty-one" "21," might be "eighty-seven" "87;" and so for any arbitrary changes deemed proper.

A new alphabet can be written at any time in a few moments. For purposes of secrecy, this may sometimes be necessary. Each letter of the alphabet is at all times indicated

by two figures, and no more. With practice, words may be signalled by this code with very great rapidity.

#### APPLICATIONS.

Number-signals, by this code of ten elements, may be made for any number that may be necessary in using naval codes, or codes arranged for many messages, to show the whole of any given number of several places at once, by placing in sight, and side by side, several men, each man standing in the signal-position proper to represent a figure of the number. Thus, Plate XVIII, Fig. 3, to show the number 3478, four men are shown side by side, about six feet apart. These are numbered from right to left of the sending signalist, who stands behind them and faces the communicating stations as Nos. 1, 2, 3, and 4.

These men assume the signal-position upon hearing the signal-number called, each man being previously informed which figure-symbol of the whole number he is to symbolize.

Then, at the call "three-four-seven-eight," for "3478," No. 1 takes the signal-position for the first figure, "3." No. 2 takes the position for the second figure, "4." No. 3 takes the position for the third figure, "7." No. 4 takes the position for the fourth figure, "8." Thus for whatever number.

The signal is recognized at the receiving station by either a conventional signal or by repeating the signal seen. Signal-numbers made in this way are always made from right to left of the sender, and are read from left to right of the reader.

The conventional signals must be predetermined. This mode of communication may be needed, as when the rolling of a ship or boat makes it impossible to steadily fix the glass upon a position. When it may be wished to conceal the fact that signals are made, the signalmen may be sheltered from observation.



# PLATE XVIII.

Fig. 1



Fig. 2



Fig. 3.



Night Signals. Torches or Fire Brands

Motions of

1.

7.

733478

Fig. 4

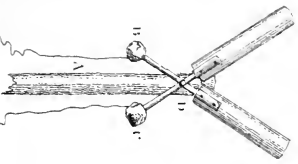


Fig. 5.

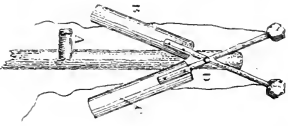


Fig. 6.

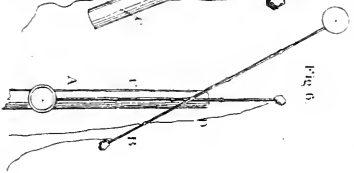
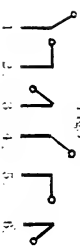


Fig. 7.



Semaphoric Positions

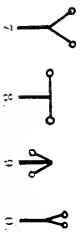


Fig. 9.



Lantern Positions

Fig. 8.

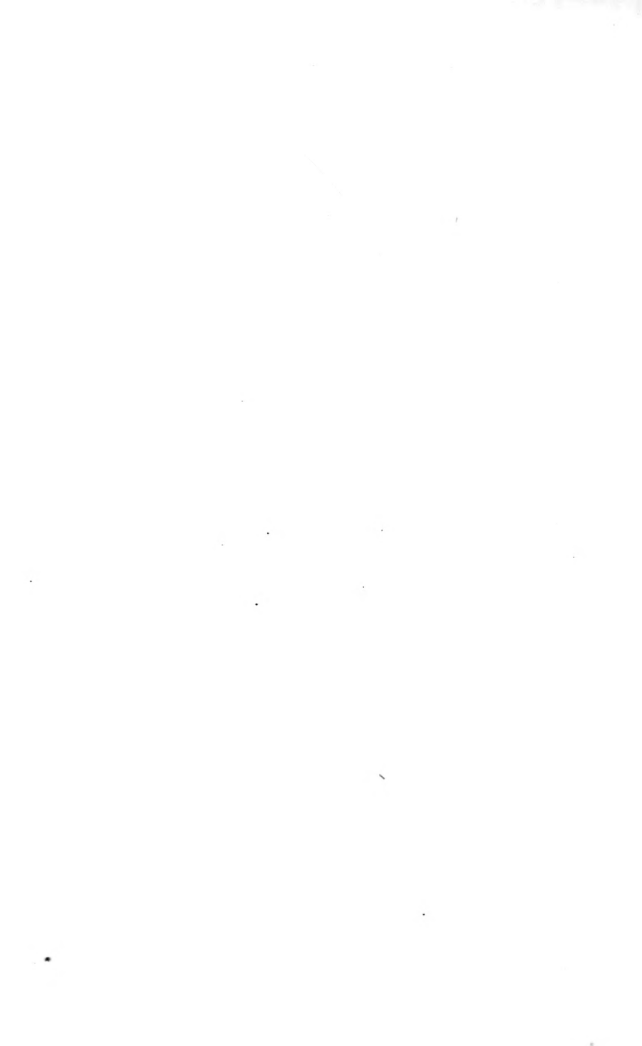


Semaphore constructed of pieces of board with weights to balance.

Position first.

Semaphore times 8 Discs

Semaphoric Signals. Signal man in tree.



The General Service Homographic Alphabet may be signalized by any of the devices before described for other codes.

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Field Signals may be made with a Field Semaphore, constructed of very common materials. (Plate XVIII, Figs. 4, 5, 6.)

Let A be any upright pole or post, however light, provided it can sustain the weight of the light arms.

B, C, arms made of light boards, or staves, or canes, with any visible disks or objects attached at the outer extremities. The working-strings or cords are attached at the inner extremities, and here are fastened weights, as shot or stones, to nearly balance the arms upon the pivot.

Let D be a pivot passing through both arms, a foot or eighteen inches from their inner extremity. This pivot is so arranged that the arms move freely upon it. It may be an iron bolt or a pivot of wood.

These are the Positions: Rest, and ten Signal Positions, the arms of the semaphore taking for each signal-number the position as described for the arms of the man in Homographic Signals. The signals, "attention," "error," "repeat," etc. Conventional signals are made by any selected positions of one arm of the semaphore. The other arm being for all of these signals kept horizontal.

The arms, which of their own weight hang with the outer extremities downward, are brought into any position by drawing upon the cords. This semaphore is constructed of the roughest materials, and can be anywhere erected and made ready for work with a few moments' labor.

It may be used at night by attaching lanterns at the arm-ends, and distinguishing a reference-sight at the pivot.

Signals with this semaphore are always numbered from

right to left of the sender, and are read from left to right of the reader.

When lines of semaphores are used, the signal at each is kept in view until it is seen correctly repeated at the next in succession. If a line of several semaphores is to be worked, an additional piece must be attached to the upright, as at Fig. 5, to render the direction of the working clear.

Semaphores of this description may be attached to and worked at the mast-heads of vessels.

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The letter-signals heretofore given may be signified by any six motions or positions, made or taken in reference to some given or fixed position.

Or by any mode in which six differing impressions can be made upon any sense; as with any six positions of a musket.

Or any six differing motions of a flag.

Or for writing by any six different marks upon paper.

Or by any six differing appearances of objects hoisted into view.

Or by any six differing colors, motions, sounds, flashes, or indications of any description. The modes by which these are produced are already illustrated.

#### SIGNALS BY FLASHES AND OCCULTATIONS.

Codes of ten elements may be signalized very simply and usefully by flashes of a single light.

The most powerful calcium or magnesium light may be used for this purpose; or the flashes may be those of any kind of lantern, or torch, or brand, or luminous object. There are used flashes and pauses.

To symbolize "one," make "one flash;" to symbolize

"two," make "two flashes;" to symbolize "three," make "three flashes;" to symbolize "four," make "four flashes;" and so on,—the number of flashes exactly corresponding with the numeral digit. The pauses are intervals of darkness. There are short pauses between the letter-signals of each letter, longer pauses between the completed letters, and at the end of words. Or "end of word" may be a long flash.

The code combinations consist each of two figures. The first figure is indicated by flashes before a pause; the second figure is indicated by flashes after a pause.

Thus to make "A," or "eleven" "11," "one flash—a pause—one flash."

To make "C," "thirty-one," "31," "three flashes—a pause—one flash."

To make "J," "fifty-two" "52," "five flashes—a pause—two flashes."

To make "R," "thirty-four" "34," "three flashes—a pause—four flashes;" and so for all combinations.

The flashes of each combination are made closely together, and the pause is so short as to distinguish it easily from the longer pause between letters, and that still longer between words. The pause may be, say for the symbol-pause, one second time; the letter-pause, two seconds; the word-pause, four seconds.

Assent is "2 2 2," ordered "two-two-two."

Error is "6," ordered "six."

Clause signal is "3," ordered "three."

Repeat is "4 4 4," ordered "four-four-four."

End of message is "3 3 3."

For illustration, to signal "on board," the signal-letters are "53.43—21.53.11.34.41.333." Signals="five flashes—pause (one second or symbol-pause)—three flashes (53);" pause *two* seconds (a letter pause), "four flashes—pause—three flashes (43);" pause *four* seconds (a word-pause),

“two flashes—pause—one flash (21);” pause two seconds, “five flashes—pause—three flashes (53);” letter-pause, “one flash—pause—one flash (11);” letter-pause, “three flashes—pause—four flashes (34);” letter-pause, “four flashes—pause—one flash (41);” letter-pause, “three flashes—three flashes—three flashes (333).”

This plan has been described at length, in order that it may be thoroughly practised. The signalist should be able to distinguish each letter by its flashes without thought, as the letters are recognized in print.

To make these flashes in the field, a common signal-lantern may be flashed from a bucket. (Plate XVIII, Fig. 9.)

Or it may be flashed from a hole dug in the ground; or from behind a folded blanket; or from behind a little embankment; or from behind a log or a board, or any screen devisable. Or a lighted portfire may be used instead of a lantern; or a lighted case of any composition fire may be used; or any light torch, or fire-ball, or a brand from a common fire. Or a fire may be flashed by raising and lowering a blanket before it.

It will be seen that flashes can be made from any part of a fort or vessel. They may be shown above a parapet or through a port-hole, or through any window of a house. The light of a light-house may be flashed by covering it with a hat or screen. The common ship-light or steamer-light can be used. The head-light of a locomotive would be visible for many miles.

At lesser distances the light need not be flashed, but held in the hand, and waved in any direction, a wave representing each flash.

Any obscuration of the light will answer as well as a marked flash. So for secret signalling: a person sitting at a table in a room lighted by a single light, may flash the light by any device. The change of light on the lighted windows can convey any message to a skilled observer out-

side. So any beam of light passing out through any crevice may be utilized. Or a person passing between a light and a window the proper times with intervals, may give any preconcerted signal. The reader will comprehend how messages may be sent by even the tapping of one finger on a table. Or by any motion that can be made with it. Such signals may be useful when blockading vessels have agents on shore to notify them of any movement; or in the case of invested forts; or they may be used by prisoners.

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One of the best apparatus for night signals by flashes when it may be necessary to turn the flash in a single direction, and that it be invisible from any other direction, is a lantern fitted precisely as the magic lantern, and furnished with a single glass "slide," like a picture-slide, colored red for half its length, and black for the remainder. When ready for signalling, the slide being adjusted and moved, the messages are transmitted in plain flashes—the flashes being cut off by the black section of the slide. The conventional signals are by red flashes—and while the lantern is at rest, it is made to show a red light. The red flash is also used to call attention. The lantern must be fitted with "sights," so that the flash may be correctly directed by "sighting," at the communicating station. (Plate XX, Fig. 5.)

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Flash signals are of the same character as Day signals by Occultations. Any thing may be obscured in any way and flashed into view. A handkerchief may be swung into view, or it may be held in the hand and waved once for "one;" twice for "two," and so on. Or to do away with the pauses, all the waves on the right of the signalist may be reckoned

as standing for the first figures of combinations, all the waves on the left as for the second figures.

Or any flag, or ball, or object may be flashed, waving into view above a parapet or any screen.

Or a shutter-shaped signal may be fitted to stand with its edge toward the observer, and be made to flash into view as has been before described.

Or a flag, or any signal, lowered a few feet from a mast-head may be run up once for "one," twice for "two," and so for any number.

Or any article, or any mode by which can be made signs sufficiently distinct to be counted, can be employed. The applications are illimitable, and can be infinitely varied. It is almost impossible to prevent communication.

After the same manner signals of ten elements may be made by sounds, as taps upon a drum or bell, or short blasts of whistles or of bugles.

Thus one tap for "one," two taps for "two," and so on. Thus: To make "one five" "15," one tap—a pause—five taps. To make "two nine" "29," two taps—a pause—nine taps. To make "three six five," three taps—a pause—six taps—a pause—five taps. Longer pauses between completed numbers.

Ten taps stand for "ten," and also for the cipher.

The sounds may be of any intensity.

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Field Signals by ten elements can thus be made by any possible indication. Embracing the numeral digits and the cipher, the plans for them have entered into general use.

Thus codes of ten elements are symbolized by the Coston Lights, as will be understood by an examination of the plans for the lights.

Or signals of ten elements may be made with any ten flags,



as in codes of naval signals. The ingenuity of all ages has been turned upon codes of this order.

Codes of whatever character or number of elements, less than ten, can be signified by using a part only of a code of signals of ten elements.

The modes of operating with ten elements, may be infinitely extended. The student should be practised in the use of signals of this order, in forming codes by them, and in the transmission of messages, until the use has become familiar and so well acquired that it will not be forgotten.

### TO RAPIDLY MEMORIZE A CODE.

The following mnemotechnic plan will sometimes be useful :

		LETTERS.					
		1st.	2d.	3d.	4th.	5th.	6th.
WORDS.	1st.	A	F	K	P	U	V
	2d.	B	G	L	Q	W	
	3d.	C	H	M	R	X	
	4th.	D	I	N	S	Y	
	5th.	E	J	O	T	Z	

If the alphabet is arranged as above for a Homographic or Position code, it will be found that, reading the columns from left to right, we have five mnemotechnic words :

1st. AFKPUV—pronounced AF-KAY-PUV.

2d. BGLQW—pronounced BE-JEL-KEW-DOUBLE-YOU.

3d. CHMRX—pronounced CHEMAREX.

4th. DINSY—pronounced DINSY.

5th. EJOTZ—pronounced EJOTZ.

The effort being to pronounce each letter in each word. The first of these words, "Afkpuv," has six letters. Each of the others has five letters. Commit these words to memory, and in the order given, so as to know them as first, second, third, fourth, and fifth words. Memorize the letters

in each word as first, second, third, fourth, fifth, and sixth letters in that word.

To recall the signal-numbers of any letter of the alphabet, pronounce the words in succession until that is reached in which the letter is found, note the *number* of the word and the *number* of the letter in the word. These two numbers, taken together, will be the signal-number of that letter. Thus the letter "M" is in "CHMRX"—the THIRD word. It is the THIRD letter in that word. The signal-number of "M" is "33." The letter "T" is in EJOTZ—the FIFTH word. It is the FOURTH letter in that word. The signal-number of "T" is "54." "P" is in the FIRST word—the FOURTH letter. "P" is "14." "V" is in FIRST word, the SIXTH letter, "16."

Suppose the word "Able" given to be signalled.

A is 1st word, 1st letter—signal "11."

B is 2d word, 1st letter—signal "21."

L is 2d word, 3d letter—signal "23."

E is 5th word, 1st letter—signal "51."

The signals then are "11—21—23—51—A-b-l-e." A signal alphabet can, by this process, be thoroughly learned with an hour's practice.

A class practised in this Alphabet, and in the Positions and Motions, in the morning, can be put in the field for exercise in the afternoon. They will need only pencil and paper to note down the signal-numbers they wish to send, or which they may receive.

This code may be so committed that it will never be forgotten. An officer practised in its use, and having his pocket telescope, can never, while in view, be cut off from communication with his fellow-officers similarly instructed.

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Field signals of eleven, twelve, and other greater numbers of elements, are used with permanent semaphores only, and

in curious plans for naval flags. By increasing the number of elements used, the number of arrangements, showing few flags in each arrangement, is very greatly increased. Thus, using sixteen different flags, there can be exhibited two hundred and forty different signals, showing only two flags at a time, or "in a hoist." There can be exhibited three thousand, three hundred and sixty signals, showing only three flags "at a hoist." There can be shown four thousand, three hundred and sixty-eight signals, showing four flags "in a hoist." (See rules of combinations.)

Lastly, as a code of twenty-six elements, we have our alphabet with twenty-six elements, each a symbol of sound or sight.

Any twenty-six different signs will represent all the letters, by showing a distinct sign for each. Or, if twenty-six sounds or notes are selected, and the sound of each be known as a letter, words sounded by these notes, in succession, would be intelligible, and as really articulated as though they were spoken.

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The lengthy and almost cumbersome descriptions of alphabets and of processes of signalling, heretofore given, have been made with the intention to so impress the student with the simplicity of the rules for forming them, and the ease with which the letters can be represented by signals, that he may never feel at a loss how to devise a signal alphabet for his own use, or how to at once form the signals with which to use it.

Signals will not be used as much as they ought to be until this simplicity is comprehended. There is hardly a military or naval movement but in which they may be of avail.

The soldiers of the signal corps signal their messages from camp to camp, to avoid the fatigue and save the time of a

few moments' walk. The sailors on fleets prefer to signal a message to the landings, to save the labor of a boat's crew.

It can hardly happen but that the advantages to follow a thorough knowledge of the uses and applications of signal-plans, will well repay, to any one fitting for a military or naval life, the little time which must be diverted from other studies to acquire it.

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## CHRONOSEMIC SIGNALS.

One of the most interesting inventions of semiologists of the present day, at once simple and effective, is that of Chronosemic or Time Signals, as they may be called.

This plan of signalling, resulting from the studies of B. FRANKLIN GREENE, Esq., of the Navy Department, was recently adopted in the navy of the United States, and bids fair to be productive of important benefits to both the naval and the land services.

It supplies a want long felt. Thoroughly understood and skilfully used, it will render intelligent communication and co-operation practicable, under circumstances which have made them hitherto impossible.

Chronosemic Signals depend for their meanings upon intervals of time. The principle will, perhaps, be best understood by an illustration. If, for instance, an interval of one second of time, taken between two signals, recognizable by any sense, is taken to represent "one" "1," then two seconds of time similarly intervening between signs, would stand for "two" "2;" three seconds intervening, would stand for "three" "3;" four seconds intervening, would stand for

“four” “4;” five seconds intervening, for “five” “5;” nine seconds, for “nine” “9;” and in this way for all the numeral digits.

The interval of time which stands for “one,” is called the “initial interval,” or “unit of interval.” It may be of less or greater length, as of one or many seconds. This is determined by the circumstances under which the signalling is to be done. The interval which stands for “two,” is twice as long as the interval which stands for “one,” because the number is twice as great. The interval which stands for “five,” is five times as long as the interval for “one.” The interval which stands for “nine,” is nine times as long; the principle being, that the unit of interval, or that which shall stand for one, being concerted, all the other numeral digits are designated each by an interval as many times greater than that standing for “one,” as the unit “one” is contained in the given numeral.

For instance, if we make a signal, allow a second of time to elapse as an interval, and then make another signal to mark the close of the interval, there is signalled “one” “1.” If we make a signal, allow an interval of nine seconds, then make another signal, there is signalled “nine” “9.” If we make a signal, allow an interval of five seconds, and then make another signal, there is signalled “5,” thus to signal “1 9 5,” or “195;” we make a sign, allow an interval of one second (for “one”); then a sign, allow an interval of nine seconds (for “nine”); then a sign, allow an interval of five seconds (for “five”); then a sign to mark the close of the interval and of the signal. Now if the initial interval, or interval unit—*i. e.*, standing for the unit “1”—had been concerted to be *five* seconds of time instead of one second of time, then to signal “1 9 5,” we make a sign; allow an interval of *five* seconds (for “one”)—a sign; allow an interval of *forty-five* seconds, nine times the interval designating the unit interval (for “nine”)—a sign; allow an interval of

*twenty-five* seconds, five times that for one (for “five”)—a sign to close the signal.

The marking signals themselves are, in this style of signalling, of use solely to attract attention, and so to mark the beginnings and the endings of the intervals.

It is necessary only that they should be defined, distinct, and capable of marking the instant with precision.

They may be, therefore, of any kind. They may be motions, flashes, objects brought into view, objects hidden, objects in positions, sounds of guns, trumpets, bells, drums, steam-blasts, whistles, flights of rockets, explosions of candle-bombs, etc.

The following explanation of Chronosemic Signals is extracted from the signal code of the United States Navy, prepared under the direction of Rear-Admiral CHARLES H. DAVIS, Chief of the Naval Bureau.

#### PRELIMINARY EXPLANATIONS.

“CHRONOSEMIC SIGNALS have resulted from an attempt, primarily, to obtain a better system of *Fog Signals* than the systems in ordinary use, either in the naval or commercial service.

“Instead of a very limited number of special signals for use during fogs, with symbols not only entirely arbitrary, but complicated and cumbrous in practice, it was proposed, in the invention of Chronosemic Signals, to devise a system which should be applicable to the various signals of an *entire code*, whether naval or commercial; with the use of symbols which might be regarded at once logical, simple, easy of application, and susceptible of precision and certainty in results.

“Every system of *Fog Signals* must be based upon the use of *sound-signs*; and these, to meet the requirements of practical use, must be combined with certain *time-intervals*,

in order to establish definite symbols of the conventional *ciphers* which represent the signals of a given code.

“The naval codes of the United States and of other nations, as well as the different commercial codes, have, as ciphers, *signal-numbers*, with the exception of the Commercial Code of the British Board of Trade—used also in the naval and commercial services of the United States—which has, as ciphers, *signal-letters*. The signal-numbers are made up of the ten elemental figures, 0 to 9, inclusive; and the signal-letters consist of eighteen letters of the alphabet, permuted in sets of two, three, and four each. In general, numerical ciphers, or signal-numbers, give rise to simpler signal operations than alphabetical ciphers, or signal-letters. The embarrassment of impracticable hoists of flags, consequent upon the large number of signals in the Commercial Code, and which led to the adoption of the signal-letters of that code, may be considered as being practically removed with the use of Chronosemic Symbols; thus admitting the restoration of the original signal-numbers.

“But the present system, although originating in an attempt to develop a better system of Fog Signals, is, in reality, an entirely *general* one, applicable to all circumstances, of day or night, open weather or fog.

“Chronosemic Signals present the following advantages:

“1. That, as a system of Fog Signals, it is readily applicable to a code of any extent; so that, for example, any signal-numbers, even of the Commercial Code, the largest of which, requiring five figures, may be made with as much facility and certainty in the densest fog as under an open sky.

“2. That, whether employed during fog or any other condition of the weather, day or night, this system makes use of the most simple and ordinary, as also the most effective, appliances for making signals in a vessel at sea; such as ships' guns, steam-blasts, trumpets, or bugle-sounds, rockets,

flashes of gunpowder, signal-lanterns, hoisting and lowering or masking a flag or other conspicuous object, etc.; requiring no perplexing and uncertain distinctions, either of colors, arrangement of colors, or of sounds.

“3. That, as a consequence of the facility with which this system uses the most simple and effective means for making the requisite signs, it is practicable to greatly extend the area of the circle of available signal-distance; as, for example, in the use of ships’ guns and rockets, where the distance may be extended to ten, fifteen, twenty, or more miles.

“4. That, as a consequence of the simplicity of this system in sign-making apparatus, there results a corresponding economy of expenditure, alike in the first cost of signal apparatus and in the cost of consumable stores for its practical use.

#### FIGURE SYMBOLS. .

“*Chronosemic or Time-sign Signals* are based upon the use of *ten different figure-symbols*, respectively representing the ten elemental figures 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Each figure-symbol consists of a certain *interval*, preceded and followed by a sensible *sign*.

“The interval *characterizes* the elemental figure for which it stands, and is simply an *interval of time which is proportional to the number of units in the figure represented*. Thus the interval for the figure 4 is twice as long as the interval for the figure 2; the interval for the figure 3 is three times as long as the interval for the figure 1, and so on. The interval for the figure 0 is theoretically *nought*, or zero; but as the initial and terminal signs would be identical with this condition, and become undistinguishable, this interval is simply made *very small*—not to exceed one second—and is thus made to preserve its practical significance.

“In order to develop the intervals, a convenient *unit of*



*interval* is chosen. This done, the interval for the figure 1 is the unit itself; the interval for the figure 2 is twice that unit; the interval for the figure 3 is three times that unit, and so on. The value of the unit chosen depends somewhat on circumstances. It should not be less than three seconds, and it may be five, ten, or any other convenient number of seconds. The following table exhibits the intervals corresponding to each figure for different units of interval, such as 3", 4", 5", 6", and 10", respectively.

*Table of corresponding Intervals.*

Elemental figures.	INTERVALS.				
	Unit, 3 seconds.	Unit, 4 seconds.	Unit, 5 seconds.	Unit, 6 seconds.	Unit, 10 seconds.
	<i>Sec.</i>	<i>Sec.</i>	<i>Sec.</i>	<i>Sec.</i>	<i>Sec.</i>
0	Very small.	Very small.	Very small.	Very small.	Very small.
1	3	4	5	6	10
2	6	8	10	12	20
3	9	12	15	18	30
4	12	16	20	24	40
5	15	20	25	30	50
6	18	24	30	36	60
7	21	28	35	42	70
8	24	32	40	48	80
9	27	36	45	54	90

"*The sign* which precedes and follows an interval, serves the twofold purpose of calling attention to the interval and of defining its limits. The conditions to be fulfilled by the signs are, therefore, simply those of fixing the initial and terminal epochs of the intervals, and of being seen or heard over the desired circle of signal distance. Objects, however simple, which admit of undergoing changes of form, of being shown and masked, or of changing place, may be used for making signs addressed to the *eye*; and all sounds, however made, whether explosive or continuous—if in the latter

case they admit of being suspended, intermitted, or otherwise changed—may be used as signs addressed to the *ear*.

#### SIGNAL-NUMBERS.

“*Any signal-number* is represented by an arrangement of Chronosemic Figure Symbols, in the order in which the figures stand in the given number. In this arrangement, reckoning from the left, the terminal sign of the first figure-symbol becomes the initial sign of the second figure-symbol, the terminal sign of the second figure-symbol becomes the initial sign of the third figure-symbol, and so on through the number.

“Hence a signal-number composed of two figures is represented by an arrangement of two intervals and three signs; a signal-number of three figures by three intervals and four signs; and, in general, *any signal-number will be made by means of as many intervals as, and one more sign than, there are figures in the given number.*

“For the purpose of a detailed illustration, suppose it were required to show the particular signal-number 2693, by means of Chronosemic Signals, the unit of interval being five seconds. From the preceding explanation it is evident that it will be sufficient to make five successive signs, separated by the four intervals, 10", 30", 45", and 15", which respectively characterize the figures 2, 6, 9, 3, of which the number is composed.

“As already remarked, and as will be more fully shown hereafter, the signs may be made in many different ways. If, however, for the purpose of the present illustration, it is supposed that the signs are made by ships' guns, then the signal of the preceding paragraph will require five guns and four intervals, which will be executed as follows:

*Gun—10"—gun—30"—gun—45"—gun—15"—gun.. 2693;*

and the signal thus made may be *shown* with entire pre-

cision by him who transmits it, and *read* with equal certainty by him who receives it.

“The preceding example may be represented graphically under the following *general form* :

$$S_2S_6S_9S_3S\ldots\ldots\ldots 2693;$$

in which the sign, whatever it be, is represented by the letter  $S$ , and the interval is reduced to units of interval by dividing each interval by the unit of interval, which in this particular case is supposed to be 5". The following examples present further graphical illustrations of the Chronosemic method of symbolizing signal-numbers :

<i>Numbers.</i>	<i>Symbolized.</i>
50	$S_5S_0S$
407	$S_4S_0S_7S$
2693	$S_2S_6S_9S_3S$
35881	$S_3S_5S_8S_8S_1S$

“Unless otherwise indicated, the *code unit* of interval will be five seconds, and the *telegraphic unit* of interval will be three seconds.

“*The signal interval* is the time which elapses between the terminal sign of one signal-number, and the initial sign of the next succeeding signal-number. This may be arbitrary, but it should not be less than the largest figure interval increased by a unit of interval; and this will be recognized as the *definite* signal interval.

“For the code unit of interval, the signal interval is, therefore—

$$5'' \times 9 + 5'' = 50 \text{ seconds.}$$

“And for the telegraphic unit of interval, the signal interval is—

$$3'' \times 9 + 3'' = 30 \text{ seconds.}$$

### AUXILIARY OR SPECIAL SIGNALS.

“The elemental figures from 0 to 9 inclusive, when *separately* made, represent certain *auxiliary* or *special signals*.

“These signals are exhibited in the following table :

*Table of special Signals.*

Figures.	Symbols.	Names of Signals.	Interpretations.
0	S <sub>0</sub> S.....	Preparatory.....	Signal of attention : <i>Signals to be made.</i>
1	S <sub>1</sub> S.....	Answering.....	Answer to call : <i>Readiness for communication.</i>
2	S <sub>2</sub> S.....	Affirmative.....	Signal of assent : <i>Yes.</i>
3	S <sub>3</sub> S.....	Numeral.....	Next signal to be used as a <i>Number.</i>
4	S <sub>4</sub> S.....	Negative.....	Signal of dissent : <i>No.</i>
5	S <sub>5</sub> S.....	Teleg. Alphabet....	Telegraphic Dictionary : <i>Alphabet to be used.</i>
6	S <sub>6</sub> S.....	Unit of interval....	Next signal to make <i>unit of interval.</i>
7	S <sub>7</sub> S.....	Signal interval....	Call for strict attention to <i>definite signal interval.</i>
8	S <sub>8</sub> S.....	Teleg. Vocabulary..	Telegraphic Dictionary : <i>Vocabulary to be used.</i>
9	S <sub>9</sub> S.....	Commercial Code ..	Signals from the Commercial Code to be used.

“*The Preparatory* signal, being intended to *arrest the attention* even of those with whom preoccupation, distance, or other circumstances may somewhat embarrass signal communication, should be made as decisive as the means at hand will warrant, or at least sufficiently so to be effective. To this end—the figure to be shown being zero—the symbol will be, in general, either *two guns, two rockets, two signal-trumpet blasts, or two steam-blasts, in quick succession.*

“If, however, circumstances should render it inexpedient to fire guns, or send up rockets, the special signal apparatus may be used, namely : the *signal balloon, lantern, or trum-*

*pet*, as made necessary or expedient by the condition of the weather.

“In every case the Preparatory will be *repeated*, either in kind or otherwise, until the proper answer shall be made, or until reasons shall appear for not expecting an *answer*.

“The other special signals need no additional explanations.

### SIGNAL APPARATUS.

“THE APPARATUS necessary for Chronosemic Signals comprises that for measuring the intervals, as well as that for making the initial and terminal signs of those intervals. Apparatus for *time-keeping* and *sign-making* is therefore required.

### TIME-KEEPING APPARATUS.

“*The timekeeper* will be any instrument adapted to the distinct and easy measurement of seconds of time.

“A chronometer, deck-clock, comparing watch, metronome, sand-glass, and seconds' pendulum, are suitable time-keepers, any one of which may be readily and accurately used for observing figure intervals.

“A *pendulum* may be extemporized in five minutes from a piece of twine and a weight, which, on being suspended between the thumb and forefinger of one hand, will give seconds' oscillations, differing less than *one-sixtieth* from strict accuracy—quite sufficient for practical purposes. The weight should be small and the string light; and the distance from the centre of the weight to the point of suspension, where a knot may be tied to mark it, should be thirty-nine inches. The small error in distance practically compensates for the small error in taking the centre of oscillation at the centre of the weight.

## SPECIAL TIMEKEEPER FOR CHRONOSEMIC SIGNALS.

"*The Signal Chronoscope* is specially designed for the correct and ready observation of figure intervals in making and receiving Chronosemic Signals.

"The Chronoscope consists of a clock movement, with a bell-striker and register. In the top of the case containing the movement there are fixed two dials, over one of which moves an index for indicating seconds of time, and over the other an index for registering units of interval. There is an adjustment by means of which the bell-striker and register may be set to the particular unit of interval desired, as 3", 5", or 10", for a given occasion. There is also a stop-detent, by which a quiescent state is maintained in the instrument, except when actually measuring figure intervals.

"To use the Chronoscope, it is wound up. The bell-striker and register are set to the desired unit of interval, and the indexes set to zero on the respective dials. The instrument may be supported on a table, or gimbals, but is most conveniently held in front of the body by a strap over the shoulder. At the moment it is desired to measure an interval, pressure is made on the knob which opens the stop-detent, upon which the second index and the register index begin to move. At the end of each successive unit of interval a bell-stroke will be made, and the index of the register advanced a corresponding space. At the close of each interval the stop-detent will be released, upon which all action ceases; and the count of the units in an interval is verified by inspection of the register.

## SIGN-MAKING APPARATUS.

"*The sign-making apparatus* is required to be adapted to two essentially different atmospheric conditions, namely:

*open weather*, and *mist* or *fog*. In the former case, the signs may be addressed either to the eye or ear. In the latter, those addressed to the ear alone can be used.

#### SIGNS ADAPTED TO OPEN WEATHER.

“As already remarked, such signs may be addressed to the eye or ear; that is, they may be *sight-signs* or *sound-signs*. The latter will be explained in describing the signs adapted to a state of fog. Signs addressed to the eye comprise :

“*First*. Signs employed during the day. For these it will be sufficient to hoist and lower a flag, ball, or any other conspicuous object; to expose and mask a ball or similar object; to expand and collapse a ball or balloon.

“*Secondly*. Signs employed during the night. For these it will be sufficient to fire rockets, candle-bombs, or gun-powder in flashes; to hoist and lower a lantern or torch; to expose and mask a lantern, torch, or any other light; to make flashes of electric light; to show, and intermit, or mask an oxy-hydrogen, magnesium, or calcium light, etc.

#### SIGNS ADAPTED TO MIST OR FOG.

“Such signs can only be addressed to the ear, whether made during day or night. These may be made by the use of ships’ guns, steam-whistles, high-pressure steam or air trumpets, fog-horns, volleys of musketry, the roll of drums, trumpet or bugle calls, etc.

#### SPECIAL SIGN-MAKING APPARATUS.

“Although the means commonly at hand would generally suffice for efficient signs, still the following special forms of sign-making apparatus will supply effective, convenient, and economical means of conducting signal operations on ordinary occasions. These are, for Chronosemic Signals—

- “1. *The signal-balloon, for day use ;*
- “2. *The signal-lantern, for night use ; and,*
- “3. *The signal-trumpet, for fog use.*

“In all cases, whatever be the particular mode of making the signs used in Chronosemic Signals, they should be prompt to time and decided in action. The actual duration of *show* of a sign may be arbitrary. It may be momentary, and at the same time efficient, with such signs as the boom of a cannon, a flash of burning gunpowder or of the electric light, and the illuminated path of a rocket or a bomb ; or it may be prolonged, more or less, as circumstances may suggest, when using any of the modes of sign-making which admit of continuous sights or sounds. But the initial and terminal limits of the figure interval interposed between two signs, however made, should admit of being observed with all practicable precision. This only requires that the transition from *show* to *mask*, or from *mask* to *show*, if a sign, be made with reasonable celerity, and noted with corresponding precision by the time-officer. In the firing of rockets, which is one of the most convenient modes of sign-making for Chronosemic Signals, where a great extension of the signal-distance may be desired, the apparent moment of explosion of the rockets may be taken as the epoch of the intervals, both in making and receiving signals.

“Nevertheless, while the remarks of the preceding paragraph suggest a care which should always be observed in conducting operations so important as the correct transmission and reliable reception of signal communications between distant points, it will be observed that an error, even of a second, or two seconds, when the unit of interval is five seconds or more, would occasion no uncertainty ; and with the use of the Chronoscope the utmost precision and certainty are attainable, even with the smallest unit of interval, both in transmitting and receiving signals.



FORMS OF SIGNAL RECORDS FOR CHRONO-  
SEMIC SIGNALS.

## SIGNAL RECORD.

*Signals made by* ——— ———,

Date. A. D. .....	Time.			Interval.				Signal number.	Remarks.
	<i>h.</i>	<i>m.</i>	<i>s.</i>	1	2	3	4		
									Signed,

## SIGNAL RECORD.

*Signals received from* ——— ———,

Date. A. D. .....	Time.			Interval.				Signal number.	Remarks.
	<i>h.</i>	<i>m.</i>	<i>s.</i>	1	2	3	4		
									Signed,

To convey letters or words by Chronosemic Signals, an alphabet may be assumed in which each letter is indicated by two figures only; as is the case with the Homographic Alphabet of the General Service Code. To designate, then, any letter, but three signs or reports will be needed. Thus to indicate A, "one—one" or "11," the initial period of time being three seconds, the signal would be written " $S_1 S_1 S_1$ ;" to indicate "R" or "34," the signal would be written " $S_3 S_4 S_4$ ;" to indicate "E" or "51," the signal would be " $S_5 S_1 S_1$ ." The three letters A R E would be thus distinctly designated. A definite signal interval may be allowed after each letter. With due care, however, the completed signals to indicate whole words may be given together—as thus: the word "A R E" may be written and signalized as follows:  $S_1 S_1 S_3 S_4 S_5 S_1 S_1$ ." Now, having this record of a signal received, and knowing there are for each letter two figures, and only two, we have, by pointing off the signal-figures by twos, the numbers of the signal-letters. In illustration, " $S_1 S_1 S_3 S_4 S_5 S_1 S_1$ " = "11, 34, 51" = "A, R, E."

In this case, the signal interval may be used to indicate completed words, the signal interval doubled to indicate completed sentences. A Signal Code and Telegraphic Dictionary, common to the Army and Navy, being then adopted, it is difficult to conceive of the circumstances which would prevent the co-operation of the forces when within any range at which sense can be acted on. For the army, the plans of Chronosemic-Signals offer many advantages: as when it may be necessary to convey a few preconcerted messages over long lines of communication, as from peak to peak, over many miles of hilly country. Corps of divisions, operating anywhere within range, by day or night, may report their arrival at fixed positions; and many facts important to be instantly made known may be transmitted.

The simple yet very powerful appliances the Chrono-

semic code permits to be used, will make it often available. Signalists will comprehend how fires, lighted from station to station, and hidden or eclipsed as by a blanket, may be so flashed to signal any numeral, and so any message. Equally, the fires being allowed to show steadily, the sharp short eclipses that may be made with a blanket or other screen may be used as signs to mark off the intervals. The Chronosemic method affords the mode by which rockets and candle-bombs can be used to the best advantage for signaling; these are among the most powerful of night signals. So, heavy bells and guns can be effectively used at great distances, or cartridge puffs, showing dense clouds of smoke by day, or powder flashes visible at great distances at night. The extemporized pendulum for counting seconds, already described, can be put in use anywhere. There is no plan more available for concealed signals, or those to be sent from within the enemy's lines. A window illuminated by a single light, placed anywhere within the room, and at proper times eclipsed, will serve to transmit any agreed message. Or any light may be flashed, or indication made in the numerous ways before suggested.

The plans for Chronosemic Signals should be made the subjects of careful study, and their practical use made a part of the instruction of every signalist. The opportunities for their successful employment cannot fail to present themselves.

## TO OPEN COMMUNICATION BY SIGNALS WITHOUT A PRECONCERTED CODE.

Two parties instructed in the principles and practice of signalling being in view, and attention called, find themselves unable to communicate, neither understanding the especial code used by the other :

TO ARRANGE A CODE.—The first party, taking position, swings the flag in circles from left to right, passing it vertically above the head in each swing, six times. Signalling thus: "Prepare to arrange code."

To this the second party replies by six similar swings. Both flags are then lowered while preparation is made. The first party writes carefully an alphabet-code of two elements (a code of two elements is chosen for illustration), taking care that each letter is represented by a distinct combination, that no two letter combinations are alike, and that the letters follow each other in their usual sequence in the alphabet, "A, B, C, etc., to Z." The second party makes ready to write down the signal combinations he is about to receive.

Each party having completed these preparations, assumes with his flag the position "Ready." It is thus known that both are "Ready to form code."

The first party now makes six times the signal "one"—a pause of three seconds. Then makes six times the signal "two"—a pause of three seconds. Then makes three times the signal "three," and lowers the flag. This shows that the code will be one of two elements, what motions of the flag will indicate each element, and what will be the pause-signal.

The second party now repeats these signals exactly as they are made, and so indicates: "Preparatory signals of elements seen and understood." He then rests.

The first party then makes slowly and distinctly the

letter-signals of his just-written code, each letter following the other in the usual sequence of the letters of the alphabet, and a pause being made after each letter-signal to permit it to be recorded by the second party. At the end of the alphabet he makes three "pause-signals" "333," and lowers the flag.

The second party, who has carefully written down the letter-signals as he has seen them made, now critically examines his list to see if all is correct; and if so, makes "22—22—22—3," and repeats slowly, distinctly, with a pause after each letter-signal and in their sequence, the letters he has received, checking each on his list as he transmits it. At the end of the alphabet he makes "33" and rests.

The first party compares these signals, as he receives them, with his alphabet list, checking each as it is compared, and if all are correct, makes "22—22—22—3."

Each party is now in possession of a complete alphabet, and the exchange of messages proceeds under the usual rules.

If, during the exchange of alphabets, there is an error or a signal not clearly seen, the receiver makes at once a "stop signal" by waving his flag from side to side. The signal seen, the sender signals "22—22—22—3," and commencing anew with the letter *preceding* that on which the error has been made, repeats these signal-letters and goes on with the alphabet.

By similar rules may be arranged signal-alphabets of any number of elements, or for any apparatus.

Homographic Codes of any number of elements may be arranged as follows:

The first party's attention being called, and the alphabets prepared, each makes, with the arm and disk, six times the motion-signals "one," "two," "three," "four," or "five," etc., for whatever number of elements he proposes to use in

his code to be prepared. He then makes, three times, the signal which is to be the pause-signal. Thus, if he proposes an alphabet of four elements, he makes motion "one" six times, then "two" six times, then "three" six times, then "four" six times. He then makes *three* times his pause-signal.

For the General Service Homographic Code he would make motion "one" six times, then motion "two" six times, then motion "three" six times, then motion "four" six times, then motion "five" six times, then motion "six" six times, *then* "Code three" "3" times.

These are repeated by the second party precisely as they have been made, to show that they have been seen and are understood. The alphabet of homographic signals is then transmitted with the same precautions as prescribed for the code of two elements, each letter-signal carefully formed by itself, and each precisely recorded and repeated back as in the instance given. Each party becomes thus possessed of the same alphabet, and messages are then transmitted by homographic signals and with the ordinary rules.

The rules for the preparation of codes of day signals without preconcert, apply equally well when it is necessary to concert signal codes at night—night-signals being then substituted for day-signals.

It will be easy for skilled signalists to thus open communication either by day or night, they needing no preconcert. It is only necessary that they be in sight of each other. The power so to do might be of value in the case of beleaguered forts or blockaded vessels, or when emergencies have long separated signalists who, though they may have no alphabet in common, may know that each has been instructed in the same rules. The practice of such communication without preconcert ought to be made a part of military tuition. So much may depend upon this power, and

it should be so assuredly possessed by every signalist, that a description at length is here given.

There are two supposable cases :

1st. Two signalists being within signal-distance, are each aware that both are practised in certain common alphabetic codes of different numbers of elements, but there is no preconcert by what order of code or by what especial signals the communication shall be.

It is supposed, for illustration, that it is desired to indicate that a code of two elements will be used, and to exhibit the signs to stand for the two symbols.

One party, having attracted the attention of the other, as by waving his handkerchief, or his arms, or a flag continually, or by running continually to the right or left of a fixed position, or by making continuously any signal, sees, by an answering signal, that he is noticed. The answering signal is made, by the second party, by repeating some sign in couplets, as by waving the handkerchief twice to the left at a time, for a number of times, or by making short runs, two at a time, to the left of any fixed position, or by any sign; only it must be repeated twice at a time, with a pause between each repetition. These double signals are always signals of recognition. The first party seeing the answer, acknowledges it by making signs of some kind "by twos." He then makes, slowly and very distinctly, six times, the signal, whatever it may be, he wishes to have read as "one," or the first element, and stands at rest. This is carefully noted by the second party, as the signal he is to read as "one," or the first element. The first party then makes, slowly and distinctly, six times, the signal he wishes read as "two," or the second element, and again pauses and stands at rest. This is noted by the second party, as before, to be read as "two," or the second element. The first party now makes, three times, the signal he intends to use for the "pause-signal," or end of a word, and stops. It will

be seen, that two elements and a pause-signal have been indicated. These are sufficient with which to construct a code. The second party, having distinctly seen and noted the signals made, now makes the signal of recognition as before, then pauses and stands at rest; then makes, in his turn, six times, the signal he intends to use as "one," or first element—then pauses; then makes, six times, the signal he intends to use as "two," or second element—then pauses; then makes, three times, the signal he intends shall be his pause-signal. If possible, the signals made by the second party must be, for each symbol, similar to those used by the first party. When this is not possible, any other signals may be used. The more simple and distinct the signals the better.

Each party now knows the number of elements the other party proposes to use, the elementary signals by which he proposes to indicate those elements, and the pause-signal.

It has been indicated that the communication will be by a code of two elements, and the signs, to stand for the two elements, have been exhibited. The parties can now converse in an alphabetic code of two elements, mutually known to them, using these exhibited symbols, in their proper places, for the elements of that code.

The procedure to indicate the use of codes of three, four, five, six, or other number of elements, and to exhibit the symbols to be shown in each case, would be similar, except that there would be three signs exhibited, each six times, before the pause-signal, to indicate a code of three elements; four signs so exhibited to indicate a code of four elements; five signs so exhibited to indicate a code of five elements; and so for whatever code.

2d. Two signalists, circumstanced as first above described, have no knowledge of any agreed alphabetic code. Each, however, is known to the other to have been instructed in the *principles* of signalling.



Then to devise a code these further rules are used :

The first party shows a signal alphabet ; that is, he makes slowly, with pauses between them, any twenty-six different combinations of the two signal-symbols he has shown. These combinations are to stand for the twenty-six letters of the alphabet.

If the combinations are to be of motion-signals, the motions for each letter must follow each other without perceptible pause between them until the combination for that letter is complete: there must then be a pause of time to show that the letter is finished. If the combinations are to be of stationary signals, each letter combination must be indicated as completed by making the pause-signal before commencing the next letter. Time must, in any case, be allowed after each letter, to permit it to be noted by the observer. The second party notes down these twenty-six letter combinations, one by one with his pencil, each in the order in which it is made, writing for each element-signal shown its proper number, as the twenty-six letters of the alphabet follow each in their usual sequence. So the record might stand thus: "A is 21," "B is 22," "C is 12;" and so on, to the letter Z. If the receiver doubts the signal for any letter, he makes the signal for the sender to stop, and then makes, with his own signals, as they have been before agreed upon, the element-numbers of the letter correctly received. The sender now commences again with this last letter, and repeats that of which there has been doubt. The first party having thus sent the whole alphabet which it is his intention to use, makes the signal for completed message; that is, three pause-signals together, and awaits the reply. The second party, having clearly seen and correctly noted, in figures, each letter-signal of this alphabet, now makes the recognition signal, to indicate that he has understood it; and then, in his turn, using his own signals—the signs he has exhibited as those he will use for "one," and "two"—he makes the twenty-six combinations

he has received, and in the same order he has received and noted them; that is, in the usual order of sequence of the letters of the alphabet. He closes with the signal for completed message. To this, the first party replies with the signal for "signal seen and understood," and the word "correct." The second party, noting this message, replies with the signals for "signals seen and understood," and the word "correct." The parties have now exchanged the alphabet, and have verified it. If, however, any letters are incorrect as returned, the first party signals after the alphabet is received, "error," then the letter preceding the fault, the faulty letter or letters, correcting them and the succeeding letter, then, "33" and pause. The second party acknowledges and repeats such correction in this pause. If there are many errors, the whole alphabet is repeated and returned. When at last correct, it is verified by the word "correct," as above. Messages of any kind can now be transmitted.

It will be comprehended that any kinds of signs or indications can be exhibited for the symbols, and that the signalists, though corresponding by the same alphabetic code, may represent the letters by signals which seem to have no resemblance. For instance, the first party may have chosen to indicate the "one" and "two" by the waves of a flag; while the second party has chosen to signify the same symbols by any two positions of a disk. The pause-signal is equally arbitrary.

Alphabetic codes, of any number of elements, may be formed whenever skilled signalists are visible to each other, by processes similar to the one described. These being the rules: that whatever signal is made continually, an indefinite number of times, is a signal for attention; whatever signal is made "by twos," is a signal of recognition or assent. So long as the signalist makes each signal six times, he is

indicating the elementary signals he intends to use; and these elementary signals are designated by the observer as the first, second, third, fourth, and so on, elements, according to the order of the sequence in which they are exhibited, one after the other. The alphabets are then devised, to consist of two, three, four, or more elements, as the case may be. The pause-signal alone is made three times; and when made, it indicates that all the elementary signals, to be used in the alphabet it is proposed to devise, have been shown. Thus, if two different signals are shown, each six times, and are followed by a pause-signal, made thrice, it is indicated that the alphabet to follow will be of two elements. If three distinct signals are shown, each six times, and are followed by a pause-signal, made thrice, the alphabet is to be of three elements. If four distinct signals are made, each six times, and are followed by a pause-signal, made thrice, the alphabet is to be of four elements; and thus for any number of elements.

Codes can be arranged in the same way, without preconcert, for the numeral characters. Communication without preconcert, or a previously established code, may be had over an electric wire as follows: For a preparatory signal, strike nine dots; the answer, "signal understood and ready to form a code," is to return nine dots. The twenty-six letters are then sent in their usual sequence by signals of any code; and these are noted down at the receiving station. The letters are then returned to the sending station precisely as they have been received. The sending station sends the word "correct," which is returned "correct," and both stations are ready to receive or transmit by any recording instrument.

The plans for Chronosemic Signals require no preconcert other than to determine the initial interval.

The power of extemporizing alphabetic codes of visible signals, of any order, and with any kind of signals, without

preconcert, other than a knowledge of general rules, and the possibility of so opening, at any time, anywhere, telegraphic communication between persons who may never have met, and may never meet more nearly than they are when thus conversing by signals, may be of use in very many contingencies of the service. For military uses, it has this advantage: that, if the parties are in sight of each other and at liberty, and can be protected, no human power can prevent their communication. It is available for beleaguered forts or cities, or vessels in distress, when communication cannot be had by boats; and between any persons who, for duty or for pleasure, may wish to communicate at a long distance. Of course, it can be used with any apparatus, or any mode of making signals, which has been described, or is conceivable. It can be used with day or with night signals, or with signals by sound.

The signalist, once well taught, becomes thereafter independent of signal-books, or codes, or especial apparatus; and, in a life of active service, may never encounter instances in which he can fail to open communication with one similarly taught, if both are in signal-distance, giving attention, and provided with the means for operation.

With these rules known, the Alphabet and the Dictionary of any language given, messages may be sent, and those may converse whose different nationalities would render conversation, by speech, impossible. In this case, each signalist signals to his correspondent, by the rules just given, in the alphabet of that correspondent's language.

The signal-alphabets once agreed upon, each signalist finds, in the signals seen by him, and standing for letters and words, the letters and phrases of his own language; and when he signals in return, he makes, with his signals, the letters and the words of the language of his correspondent. An American, in distress, might thus signal intelligible messages on the coast of Russia, or France, to the na-



# PLATE XIX.

Scale 1 ft. to  $\frac{1}{2}$  in

Fig 2

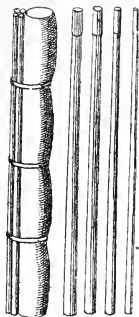


Fig 1.



Fig 3.

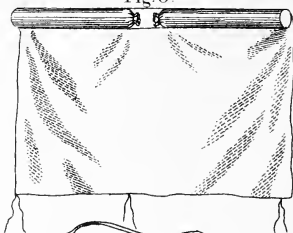


Fig 5.



Fig 6.



Fig 4



Scale 1 ft. to 1 in

Fig 7.

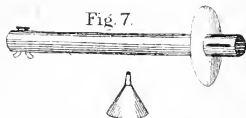
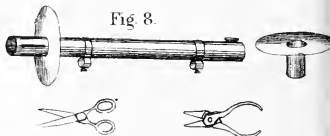
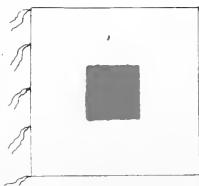
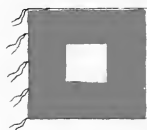
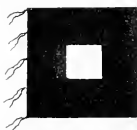
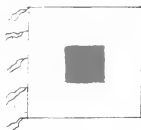


Fig 8.



Scale 1 ft. to  $\frac{3}{16}$  in

Fig 9.



tives of those countries. Or signalists of different nations, coming in sight of each other, might converse, understandingly, miles apart, by messages thus written in the air—for to signal by aerial signals is virtually to write letters in the air—when neither of them would be able to comprehend the spoken pronounciation of the words that had been thus transmitted. The dream of a universal language is, perhaps, as nearly realized by these simple devices as in any way hitherto suggested. The tongues, not the eyes, were confounded at the tower of Babel.

In the studies of a military education, the most thorough practice, in the modes of thus communicating without preconcert, ought to be insisted on.

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## DESCRIPTION OF STANDARD SIGNAL EQUIPMENTS.

A Regulation Set of Signal Equipments, when packed complete, is comprised in three pieces:

The Kit—or canvas signal-case, containing the signal-staff, flags, torch-case, torches, and wormer. These all compactly rolled together and bound by straps, as at Fig. 1, Plate XIX.

The Canteen—made of copper, with one seam, and soldered—capable of containing one half-gallon of turpentine or other burning-fluid. (Fig. 6.)

The Haversack—in which are packed wicking, matches, shears and pliers for trimming torch, a small funnel for filling the torch, and the two flame-shades, etc. (Fig. 4.)

The Kit Case, Canteen, and Haversack are fitted with shoulder-slings or straps, by which they may be easily carried.

The Service Can—is a strong copper can, with rolled seams hard-soldered. The nozzle is fitted with a screw-cap,

to prevent leakage. It is capable of containing five gallons of burning-fluid. (Fig. 5.)

The Kit Case contains :

1st. The signal-staff—a staff of hickory, made in four joints or pieces, each 4 ft. long, and tapering as a whole from  $1\frac{1}{4}$  in. at the butt to  $\frac{1}{2}$  in. at the tip.

The joints are feruled at the ends with brass, and fitted to be jointed together as some fishing-rods are jointed. The third joint is guarded with brass for six inches at its upper extremity, to protect it from the flames of the torch, which is always attached to this joint.

The tip or fourth joint is that to which the flag is attached for day-signals. When in use, two or more joints of staff are fitted together. (Fig. 2.)

2d. The Signal Flags—made of muslin, linen, or some other very light and close fabric. The flags are seven in number.

1. The six-foot white—six feet square, white, having at its centre a block or square of red, two feet square.

2. The six-foot black—six feet square, black, having at its centre a block or square of white, two feet square.

3. The four-foot white—four feet square, white, having at its centre a block, red, sixteen inches square.

4. The four-foot black—four feet square, black, having at centre a block, white, sixteen inches square.

5. The four-foot red—four feet square, red, having at centre a block, white, sixteen inches square.

6. The two-foot white—two feet square, white, having at centre a block of red, eight inches square.

7. The two-foot red—two feet square, red, having at its centre a block of white, eight inches square.

All of these flags are fitted with tapes or ties, by which to tie them to the staff. This is found the most simple and the best mode of attaching. Two tapes, six inches long,



and sewed together at the tie-edge of the flag, make a tie. The ties are one foot apart. (Fig. 9.)

### 3d. Torch Case and Torches.

The Torch Case is a piece of rubber cloth about three feet long by two feet six inches broad, fitted on one side with pouches, in which the torches are inserted.

At the opposite edge are ties. The torches are packed by being placed in the pouches, with the case then rolled around them so as to envelop them in two or three folds of cloth. The ties retain the package in this form. (Fig. 3.)

The Flying Torch—is a copper cylinder, eighteen inches long and one and one-half inch in diameter; it is closed at one end, with the exception of a nozzle, through which it can be filled, and which closes with a screw-cap; it is open at the wick end, and on its sides, at this end, are four fenestra or openings, one inch long, half an inch broad, which open into the wick, so providing that however the flame may be driven by the wind, it will find a portion of the wick exposed. (Fig. 7.)

The Foot Torch—is a copper cylinder, eighteen inches long and two inches in diameter. It is similar in its structure to the flying torch. (Fig. 8.)

The torches are trimmed by fitting into the mouth a wick of cotton wicking six inches long. This must fit closely. The body of the torch is then filled with turpentine or other burning-fluid, as petroleum, etc. The flying torch attaches to the staff "third-joint" by clamp-rings and screws.

Flame Shades.—Each torch is fitted, when in use, with a flame-shade—a ring of thin copper, two inches wide, and fitting by a socket upon the torch in such a way that the ring projects on all sides. This is placed about one inch below the fenestra or openings. The use of this shade is to prevent the flame from travelling down the side of the torch and thus over-heating it. The flame-shade is always detached when the torch is packed.

A shade, called a Wind Shade, is sometimes used in high winds. It consists of fine strips of copper attached to a socket, and is adjusted upon the torch in the same way as the flame-shade.

The Funnel, Pliers, and Shears are used for filling and trimming the torch.

A screw or wormer is placed in the torch-case to be used when the wick may, by accident, be drawn so far into the tube of the torch that it cannot be seized by the pliers.

The Service Set of Signal Equipments consists of fewer pieces than those here given.

The modes of using them are, however, identical.

The Service Set consists of

The Kit—containing a four-foot white flag, a four-foot red flag, a flying torch with flame-shade and extinguisher, a foot-torch with flame-shade and extinguisher, a funnel, a pair of pliers, a pair of scissors, a wormer, and a three-jointed staff.

The Canteen.

The Haversack is furnished with some and omitted in other styles of the Kit.

Plate XIX, Figs. 1, 6, 4. There are represented the kit complete, packed in the signal-case; the canteen and the haversack.

Fig. 2. The kit rolled ready to be placed in the case; the torches packed in the torch-case; the flags rolled closely together; the four joints of the staff;—the whole bound by the packing-straps.

Fig. 3. The torch-case.

Fig. 5. Service-can.

Fig. 6. Service-canteen.

Fig. 7. The flying torch.

Fig. 8. The foot-torch.

Fig. 9. The different flags in outline—showing the relative size.

1821

2 1/2

62

1821

10

62

# PLATE XX.

Fig. 7.



Double Disc

Fig. 6.

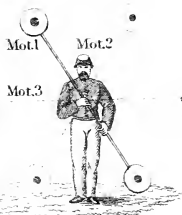


Single Disc



"Ready"

Fig. 8.



Motions "1 2 3"

## Lantern Signals.

Fig. 1.

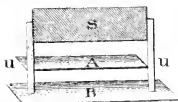


Fig. 2.

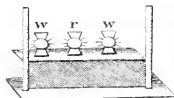
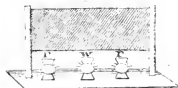
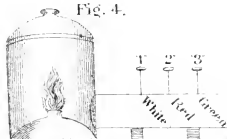


Fig. 3.



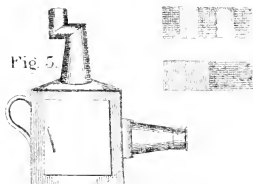
A B Shelves S. Screen moving vertically w.r.w. Lanterns white, red, white, placed on Shelves and changed in position to make any Signal.

Fig. 4.



Flash Lantern showing white red & green Flashes.

Fig. 5.



Magic Lantern with colored Slides

## SIGNAL DISKS.

*Single Signal-Disks* are made of white canvas or other strong cloth, stretched upon light rings or hoops of wire or tough wood, and having attached handles, by which they may be conveniently grasped and moved.

The disks are about a foot or eighteen inches in diameter. They bear at the centre a round black or red spot, of a diameter equal to about one-fourth that of the disk.

The handles are from a foot to eighteen inches in length. They may be fitted with sockets, so as to permit the disk to be attached to longer rods or handles when there is the occasion.

Signal-disks may be attached to long and light canes, or to the end of a musket, or to the arms of a semaphore, to add to their utility.

*Double Signal-Disks* consist of two signal-disks, one attached at each extremity of a staff about six feet long. The disks are about eighteen inches in diameter. They may be of the same color, or of different colors, as one red and one white.

The dependence in signalling should be on the position and not on the colors of the disks. These are often not distinguishable. Disks are sometimes colored red on one side and white on the other. This device is useful, permitting the color of the disk to be suited to the background. Disks intended for constant use, as at permanent stations, are sometimes woven of basket or wicker work.

There are represented, Plate XX—Fig. 6, Single signal-disk; Fig. 7, Double signal-disk; Fig. 8, Double disk in use.

## SEMAPHORES.

When, on long lines of stations, towers or other structures are used, it may be necessary, for greater speed, to

sometimes employ semaphores for aerial telegraphy. Little attention has been paid, in our army, to the great advantages, sometimes, of their employment: the modes of signalling in use dispensing, in a very great measure, with the necessity for them. On lines of one or two hundred miles in length, and permanent, they may be useful. Semaphores consist of a post with arms. The arms starting with about three feet in length, to be increased one foot for every mile. These arms are made movable by ropes passing over wheels or pulleys, and moved by a crank below. The arms should be capable of making twenty-six different positions. This is all that is absolutely necessary. Each position stands for a letter of the alphabet. A pointer on a dial-face, placed at the foot of the machine, indicates what letters the arms are showing when the crank is in each position. When a letter is made, it is kept in view until it is seen repeated at the next station; the next letter is then made; and so on. A watch is kept with a telescope, at each station, in two directions—that from which the message is to come, and that to which it is to go. Each signal made is kept in view, at the sending station, until it is seen correctly made at the next station. If the receiving station erroneously repeats any signal, the sending station still holds the correct signal in view until it is rightly repeated.

The use of semaphores has been carried to very great perfection in Europe, and elaborate accounts of their structure are readily attainable. It is not necessary here to enter into a lengthy description.

The plans of CHAPPÉ are the most elaborate. The plans of POPHAM are sufficient for all uses likely to be made in this country.

Semaphores are worked at night by attaching lanterns to the upright, as a point of reference; other lanterns being affixed at the ends of the arms. The lanterns are always troublesome.

The plans for semaphores before given have sufficiently illustrated the devices by which they may be formed.

[Plates IV, XIV, XV, XVI, XVIII, etc.]

They may be of the simplest structure.

A strong pole and a couple of light canes, with some light rope or strong twine, are sufficient material to construct any variety of semaphore.

Or the canes may be worked as attached to the trunk of any tree—the tree-top branches, etc., being cut away.

Or any kind of post may constitute an upright, and any kind of rod or staff, or piece of plank, may answer for the arms.

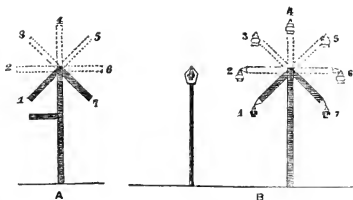
The arms may be attached by wooden pivots, or they may be tied with ropes, so as to move freely in any necessary direction. Where canes are used as arms, disks, or balls of hay wrapped in white cloth, are attached to their extremities, to increase their visibility.

The following description and illustration is extracted from Scott's Military Dictionary.

#### SEMAPHORE TELEGRAPH.

“It consists of an upright post, of moderate height; of two movable arms, fixed on the same pivot, near the top of it; and of a mark, called an

indicator, on one side of it, merely to distinguish the low numbers, 1, 2, 3, from the high numbers, 7, 6, 5. Fig. A represents the telegraph exhibiting the sign 17, the other positions of which the arms are capable being dotted. Fig.



B represents the telegraph fitted up to make nocturnal signals. One lantern, called the central light, is fixed to the same pivot upon which the arms move. Two other lanterns are attached to the extremities of the arms. A fourth lantern, used as an indicator, is fixed on the same horizontal level with the central light, at a distance from it equal to twice the length of the arm, and in the same plane nearly in which the arms revolve. Hence, the whole apparatus consists of two fixed and two movable lights—four in all. The number of telegraphic signs, combinations, or changes which this telegraph is capable of exhibiting, is shown in the ‘Table of Signs or Combinations’ (see cut on page 197); and one of those, No. 4, in the day telegraph, is liable to be confounded with the post, and should not, therefore, be used. The number is, however, amply sufficient for telegraphic communication, whether by alphabet or by reference to a telegraphic dictionary of words and sentences. The indicator, both by day and night, is merely a mark, and nothing more; and the central light by night, and the post by day, are also merely guides to the eye. The signs of the telegraph are in reality, therefore, only composed of combinations of two movable bodies by day, and two lights by night. It has been ascertained by experiment that the arms for day-signals should be about one foot in length per mile, in order to be distinguished by a common portable telescope. By the above rule, a telegraphic arm of six feet in length may suffice for stations six miles apart; but it is better to add a little to these dimensions. The width of the arm need not exceed two-thirteenths of its length. The indicator should be of the same width, but only four-fifths of the arm in length. The height of the post should be such, that movable objects near it should not obscure the indicator or arms, when the telegraph is erected in the field. The telegraphs hitherto constructed on this principle are of two sizes: one having arms of five and a half feet in length,



TABLE OF SIGNS OR COMBINATIONS.

1			25		
2			26		
3			27		
4			34		
5			35		
6			36		
7			37		
12			45		
13			46		
14			47		
15			56		
16			57		
17			67		
23			STOP		
24			FINISH		

with the lantern-pivots placed six and a half feet from the centre of motion; the other having arms, two and a half feet in length only, with the lantern-pivots three feet two inches from the centre of motion. The latter are perfectly portable, as the whole apparatus does not weigh more than thirty-four pounds. In clear weather these small telegraphs make signals distinctly visible at a distance of three miles.

“In cases of emergency, where the portable telegraph is not with an army, it has been ascertained by experiment that the most expeditious and satisfactory arrangement will always be to copy the regular construction as closely as circumstances will permit. A post, with two planks for the arms, fixed externally on each side of the post, each worked merely by a couple of strings, without pulleys, will constitute a day telegraph; and the addition of lanterns will convert the same simple apparatus into a night telegraph. In both cases the arms must be counterpoised by wood or iron, and also by weights in some rude manner, which must not impair the clearness of the telegraphic signs.”

Three lights will be sufficient for the ordinary uses of this semaphore at night, if the pivot light is made distinguishable by its brilliancy or its color from the lights at the ends of the arms.

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## FLAGS ON HALYARDS.

When flags on halyards are used as signals, they are fitted with “loops and toggles,” so that when flown they are kept each at a distance from the other, somewhat greater than its length. (Plate XXI.) Flag-signals are read from above, downward. Each flag represents a numeral digit. The naval signal-flags are numbered from 0 to 9. To illustrate their use: If red is known as “4,” yellow as “3,” and blue as “2,” to make the number “423,” these flags would be flown

# PLATE XXI.

Fig 1

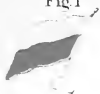


Fig 2



Fig 3



Fig 4



Flags connected by  
Loops and Toggles.

Flags hoisted N° 1234  
Distance Line

'423' Symbolized.

Fig 5.



Fig 6.

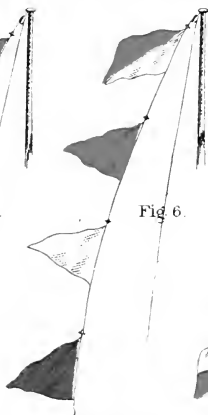
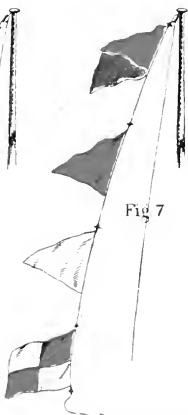


Fig 7



To Repeat 1<sup>st</sup> & 3<sup>d</sup> Flags  
N° 4433.

To Repeat 1<sup>st</sup> Flag  
3 times N° 2222.

To Repeat 1<sup>st</sup> Flag Twice  
As in N° 1114.



together upon halyards—red above (4), blue next (2), white below (3)—“423.” It is rarely necessary to fly more than four flags together, or “in a hoist,” as it is styled, when the naval code is used. The numbered naval flags are generally of two colors combined in one flag. In addition to the numbered flags, are certain pennants known as repeaters, by which is shown any numbered flag which is intended to be read as “repeated,” or occurring twice or more times in any signal.

Signal Flags are run up on what is termed a signal halyard (a rope passing through a pulley fixed at the masthead or other elevated point) and having at one of its ends a loop and at the other a toggle. (Plate XXI, Fig. 3.) The toggle at the top of the upper flag and the loop on the cord at the bottom of the lower flag are fitted, the first into the halyard loop, and the second over the halyard toggle. The flags are then hoisted by the halyards. The continuous line formed by attaching several flags together by means of the loops and toggles, is called the “distance line.”

Flags may be extemporized from common materials, as pieces of canvas and of cloth, strips of white, red, or blue flannel, etc. It is necessary only that they be distinguishable from each other. These are displayed in the same way, and the signals are read in the same manner. When the number of distinguishable flags is limited, the codes must be arranged to contain that number of elements only which may be indicated, using a distinct flag for each element.

Where there is material of one kind only, variously *shaped* flags may be made. The distinction being then made by the differing forms of the flags.

Signal-flags are made of bunting, which is purposely of such texture as to catch the air, that it may fly with a light breeze. There is appended to this book (Plate II.) a plate of flags as now used in the navy. By reference to this and

the example of naval codes (page 47,) it will be understood how the sentences therein, or any others, may be represented.

Plate XXI illustrates the modes in which the flags may be shown.

Let it be supposed, that the four flags shown on Plate XXI, Fig. 3, symbolize respectively, taking them from above downward, the numbers 1, 2, 3, and 4; then if all of them are hoisted together, as in Fig. 3, the signal-number 1234 is understood as shown. Any less number of them may be hoisted together, as in Fig. 4—the number 423 is shown. In Figs. 5, 6, and 7, the use of the “repeaters” is exemplified. In Fig. 5, is shown the number 4433; in Fig. 6, the number 2222; in Fig. 7, the number 1114. (See page 54.) The red, white, and blue pennants are taken respectively for the first, second, and third “repeaters.”

Any articles, as coats, caps, handkerchiefs, boots, tin pans, etc., can be designated by numbers, as 1, 2, 3, 4, and so on, and then hoisted one above the other, in their proper order, on halyards, to signify any signal-number. (See Plate XIV, Fig. 9.) Even the “repeaters” may be devised if needed.

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## FLAGS IN MOTION.

When signals are to be made by flags in motion, it is necessary to take care that the flags are of bright colors and clean; that such colors are selected as will most strongly contrast with the background against which the flags appear when viewed by the person receiving the message; that they are of material, light, smooth, and which will glide easily through the air, as cotton or linen stuffs—instead of bunting; that the colors are so arranged as to be pleasing to the eye, which else is sooner wearied.

The motions must be rapidly made, those of each combination without perceptible interval between them. There must be care, and the skilful handling acquired by practice, to prevent the entangling of the flag upon its staff. The motions must be so made as to display in the lateral waves the whole surface of the flag toward the point of observation. It is by the quality of the motion of the object producing a vivid and prolonged effect upon the eye, that signals by motions are capable of being used at great distances.

In the case of night-signals there is this additional gain, that the motion through the air furnishes a supply of oxygen to consume the surplus carbon of the torch-flame, giving thus a light more brilliant than could be otherwise had.

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### SIZES OF FLAGS AND LENGTH OF STAFF.

There are in the Regulation Signal Equipment three kinds of signal-flags—the white, the red, and the black; and three sizes of flags—the “six-foot,” “four-foot,” and “two-foot,” or action flag. In the “Service Set” four-foot flags only are furnished.

The signal-staff consists of four joints, each four feet long, and fitted with ferules to join to each other joint by joint, and so to furnish a staff of greater or less length. They are known as the first, second, third, and fourth joints. The third joint is tipped with brass, and is that to which the torch is attached for night-signals.

For the “Service Set” there are three joints, the torch attaching to the second.

The equipment thus admits of four styles of using the flag apparatus: 1st. A single joint of the staff with the “action-flag,” for short distances. 2d. Two joints of the staff, with either the “four-foot” or the “action-flag.” 3d. Three joints of the staff, with either the “six-foot” or “four-

foot flag." 4th. Four joints, or the whole staff, with either the "four-foot" or "six-foot flag," for the greatest distances. (Plate XIX ; and Plate X, Figs. 3, 4, 5, 6.)

Where it is difficult to attract attention, two flags are sometimes used together upon the whole staff.

In case of exposure to an enemy's fire, it is sometimes necessary to increase the length of staff, so that the signals may appear above some shelter while the signalist is protected.

The apparatus for the greatest distances is rarely used. The four-foot flags are for use in ordinary working, and should be habitually used with the twelve-foot staff. The use of the four-foot flag should be compulsory. The temptation is great on the part of the flagman to substitute for it, at improper times, the action-flag, and thus needlessly render the transmission of messages difficult and uncertain.

The two-foot or action flag is for use in exceptional cases only. An *action-flag*, as its name indicates, is for use when a heavy fire may compel the flagman to lie down or to seek shelter, while the signals must, at the same time, be made. This flag can be read sufficiently well with the telescope, its exact position being once determined, at any distance likely to be needed on the field of battle. This flag is useful in reconnoissances near the enemy, when some fixed point being agreed on from which to report, it can be used with little danger of attracting the attention of the enemy. Thus it may be used in any opening among the trees, at a place previously concerted, and it will be thus hidden from the enemy, and be in view to the observing officers. The preconcert is necessary to prevent the difficulty of finding the flag, otherwise to arise. It should be always so particular that there can be no misunderstanding. No station should be permitted to use this flag for ordinary communication without the especial permission of the officer in charge of the detachment. The stations to use action-flags should be



carefully selected and established on the lines prior to an action, and the glasses at the communicating stations should be fixed upon them. These points should be hidden from the enemy, if possible.

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### LANTERNS.

Some description of flash-lanterns has been given at page 88. Colored lanterns may be used as signals, being swung upon a halyard, and a signal-number being indicated by each, thus: White, standing for *one*; red, standing for *two*; green, standing for *three*. When lanterns are used in this way they are suspended one above the other, and about three feet apart. The signal is read from above downward. Thus "321" would be shown by lanterns hung in the following order: a green lantern above (3), a red lantern next (2), a white lantern below (1). Lanterns indicating signal-numbers may be arranged horizontally. The signals are then read from the left to the right of the observer.

Letters can be signalled with some speed by the use of colored lanterns; the lanterns standing on a frame or board, and their relative positions rapidly changed by hand to make each letter. All the lanterns must be eclipsed to mark the end of each letter; longer eclipses mark the ends of words and sentences.

A plan of a frame for this signalling is given in Plate XX, Figs. 1, 2, 3. The lanterns w-r-w, hidden by the screens, are placed on either shelf in the order to make any letter. The screen is then raised and the signal exhibited as long as may be necessary, when the screen is again lowered. Two sets of lanterns can be used, one for each shelf. In this case, the letter-signals are arranged on the shelves alternately—those on the upper shelf, while the lanterns on the lower are exposed; and so for each in turn.

Flash Lanterns, flashing white, red, and green by springs, are complicated in structure, and are apt to be disabled by accidents.

The Magic Lantern, with a "flash slide," to flash white and red only, as at Plate XX, is perhaps the best form to be used for signalling.

This lantern is wholly dark until it is opened for use. It is then dark in all directions except that in which the lens-tube is turned. The flash is intense. The lens-tube can be adjusted to give the best light at different distances. The structure is light, strong, and not liable to be deranged. The glass slides can be so made as to be almost safe from breakage. The whole requires no more care than a common lantern.

The flash-slide can be worked by being moved back and forth by the hand. Or it can be made to move mechanically by the working of a handle attaching to it by simple appliances, so as to flash with great precision.

The slide may be so colored as to cause white, red, and green flashes, and so be used for any code of signals. (Plate XXI.)

Common lanterns are fitted to change color by a chimney of colored glass adjustable over the flame, and moved without opening the lantern. A single lantern may be thus changed at will to be white, or red, or green. This style is convenient for ship use.

Four lanterns of this kind are all that need be had on deck, at one time, to make any signal.

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## TORCHES.

The "flying torch" and the "foot-light" of the standard signal equipment are already described.

Signal-torches were devised to meet the requirements of

active service ;—to furnish the most brilliant light ; one that could be lighted in the open air, or in rain, at any time ; to be put in rapid and constant motion ; to be inextinguishable by wind ; to have little weight ; to be used without glass ; to be simple and strong, with no breaking parts ; to be carried anywhere, on horseback or on foot ; to endure the constant vicissitudes of the most active and roughest service. There are scissors, pliers, and funnel for trimming and filling the torch.

Signal-torches consist of a cylinder of copper closed at one end, and so arranged that they may be filled with any burning-fluid. Turpentine is generally used ; and when prepared for signalling, a saturated wick of cotton strands, of the size of the cylinder and about six inches long, is inserted in the “light-end” of the torch. The wick being first prepared, is introduced by a twisting or screwing motion : the torch is filled with turpentine and the wick is lighted. (Plate XIX ; and X, Figs. 5, 6.)

The copper of the torch becomes heated, and so converts a portion of the turpentine into a gas rich in carbon, which, to escape, must pass through the flame of the wick. The rapid motions in signalling, driving the torch through the air, furnishes a supply of oxygen to heat a portion of this surplus carbon, and there is thus had great brilliancy of light.

With torches, as with flags, the effect of the motion of a signal to produce a prolonged and vivid impression upon the eye, adds much to their usefulness for signals.

Signals by torches are easily read at a distance of ten miles, and have been often used at fifteen. Signal-torches may be used for any plan of signalling for which lights of only one color are needed.

It is probable that torches can be very much improved, or a better light may be substituted for them. If wicks of asbestos cloth or wire-gauze could be substituted for those

in common use, it would be a valuable improvement. These would give no sparks and require no trimming. It is possible the magnesium light may be applied to this use for signalling.

As a general rule, if stations once established are not more than ten miles distant, the regulation torch-light, shown in motion at one, will be seen with the naked eye, or the marine glass, at the other, as a light sufficiently strong to attract attention.

When working at night, the foot-torch is to be filled as often as it becomes exhausted, without stopping signals or extinguishing its light. If it becomes necessary to fill the flying torch, while transmitting a message, drop the torch to the left, extinguish and fill it in that position, and then light it again at the foot-torch; bring it, thus lighted, vertically above the head, which is the signal that the message is to proceed and go on as before.

It should be observed with care that the wicks of the signal torches are properly adjusted. If the wicks are too tight, the torch will not burn well. If they are too loose, the turpentine will escape, and it will burn too violently. The wick of a flying torch is properly trimmed when the flame of the burning torch seems to be about three inches in diameter.

When a flying torch becomes too much heated while working—a fact which will be known by the sighing sound and increased size of the flame—the working must stop for a few minutes, and the torch be held up, the signal-staff being kept perpendicular, until the flame has diminished to a proper size. A flying torch should be filled, on the average, every fifteen minutes. If the torch is not kept well filled, it will continue to burn, but the wick will be reduced to a cinder; one wick, properly managed, and with care to keep the torch well filled while in use, will last for a week.

When the wind blows from such a direction as, by driving back the flame of the foot-torch, to render the light of that torch indistinct when viewed from the communicating station, so place the torch as to bring the wind-shade upon it in direct opposition to the wind; and if this should not suffice, build behind the torch a screen, about two feet high and two feet long, of stones, earth, boards, or any other material, so that while the foot-torch is in front of the screen, and in view of the communicating station, its flame will be in the dead air, caused by and in front of the screen.

In cases of emergency, torches may be constructed of pitch-pine, old cordage, canvas, rags, or other material, saturated with tar, or with any combustible fluid. Firebrands, or any lights, will answer the purpose. With the preceding instructions of the Manual, the signalist need hardly have in question the devices to be used. Any light that can be visible will afford sufficient means by which to transmit signal messages in any variety.

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### CANDLE-BOMBS.

Candle-Bombs are pasteboard shells, charged with brilliant stars. These shells are so fitted with fuses that they can be thrown into the air and exploded at a great height. They afford very distinct and marked signals. The bombs are of various sizes, in diameter, from four to ten inches. When the bomb is prepared for use, there is attached to it an ordinary cartridge of powder fitted with a long match. These bombs are fired from bomb-guns or mortars, which consist of a hollow cylinder formed of thick pasteboard, sole-leather, or sheet-copper, two or three feet in length, of sufficient diameter to readily admit the bomb, and closed at one end by a block of wood or a plate of some metal. Where others cannot be had, mortars for this purpose may

be hollowed from pieces of tough wood. A tube of the proper size of almost any strong material, and closed at one end, will serve the purpose of a mortar.

The mortars may be fitted with a lock, for the purpose of firing.

To load the mortar, the bomb, with the cartridge attached to its lower side, is placed in the cylinder; care being taken that the firing match, which is to ignite the powder and which also leads to the fuse of the shell, projects a suitable length above the shell. The charge is fired by igniting this match. (Plate XXII.) These mortars are light and strong, and can be carried anywhere, on horseback or on foot. The bombs are as easily transportable as any other kind of ammunition. The signals made by the explosion of these shells are as marked and powerful as any that have been devised. The apparatus is free, both in its transportation and use, from many of the inconveniences that attach to rockets.

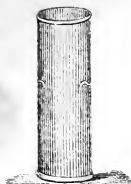
Signal-mortars charged with powder only, can be used to make smoke-puffs by day. There will be the advantage that the puff is accompanied by the report of the mortar.

Candle-bombs can be so charged as to give, when fired with a match, a loud report, and so serve many purposes—as to attract attention or to alarm on the approach of the enemy. It is said that wooden shells may be made to give a report as loud as that of a six-pounder. Such shells are turned in halves, and screwed together. If the bomb is fired from the mortar, there will be the additional advantage, that this explosion will be at a considerable elevation.

There will be, to attract attention, both the report of the bomb, and the puff of smoke from its explosion.

Outposts, upon roads by which an enemy is expected, may be supplied with both mortar and bombs, as is best; or with the bombs alone, to be exploded upon the approach of a hostile force.

# PLATE XXII.



Signal Mortar

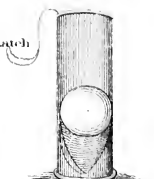


Candle bomb with Cartridge attached



Candle bomb

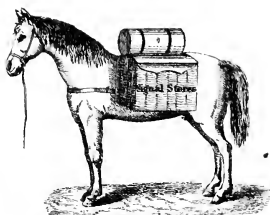
Lighted match



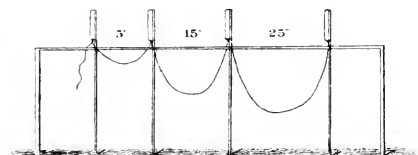
Signal Mortar charged with Candle bomb. match lighted



Signal Man with kit complete.



Pack animal with Panniers and Mortar.



Signal Number 1 3 5 = 135  
Rockets with time matches for chronosemic signals



Firing rockets from the hand.



Rocket head and stick





For transportation, candle-bombs may be conveniently packed in panniers, to be borne by a pack-animal, the mortar being packed upon the saddle.

There are no articles more effective for signal purposes than the signal-mortar with its bombs. Their general use will develop possibilities of signalling which have not hitherto been conceived.

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### PUFFS AND FLASHES.

Puffs of smoke may be made by day, or flashes shown at night, by igniting any quantity of powder by means of a quick-match; or by flashing it upon coals, if the quantity is small.

A convenient form of package is the common cannon cartridge, in which may be inserted a length of quick-match when it is to be fired. The cartridge can be carried in a pouch or in panniers.

Powder-flashes can be seen at a great distance at night. The quantity of powder to be in each flash can be increased in proportion to the distance at which the signalling is to be. The firing must be with proper precautions.

Flashes of colored fires may be made by burning them upon an iron pan; or when the signal is to be for a great distance, or is to attract attention, as of a beleaguered garrison, a quantity of the composition, as half a pound or a pound, must be heaped together and ignited by a match.

In General Marcy's "Prairie Traveler" are these suggestions:

"Very dense smokes may be raised by kindling a large fire with dry wood, and piling upon it the green boughs of pine, balsam, or hemlock. This throws off a heavy cloud of black smoke which can be seen very far.

"This simple method of telegraphing, so useful to the savages both in war and in peace, may, in my judgment, be used to advantage in the movements of troops co-operating in separate columns in the Indian country.

"For example, when two columns are marching through a country at such distances apart that smokes may be seen from one to the other, their respective positions may be made known to each other at any time by two smokes raised simultaneously or at certain preconcerted intervals.

"Should the commander of one column desire to communicate with the other, he raises three smokes simultaneously, which, if seen by the other party, should be responded to in the same manner. They would then hold themselves in readiness for any other communications.

"If an enemy is discovered in small numbers, a smoke raised twice at fifteen minutes' interval would indicate it; and if in large force, three times with the same intervals might be the signal.

"Should the commander of one party desire the other to join him, this might be telegraphed by four smokes at ten minutes' interval.

"Should it become necessary to change the direction of the line of march, the commander may transmit the order by means of two simultaneous smokes raised a certain number of times to indicate the particular direction; for instance, twice for north, three times for south, four times for east, and five times for west; three smokes raised twice for north-east, three times for north-west, etc., etc.

"By multiplying the combinations of signals a great variety of messages might be transmitted in this manner; but, to avoid mistakes, the signals should be written down and copies furnished the commander of each separate party, and they need not necessarily be made known to other persons.

"During the day an intelligent man should be detailed

to keep a vigilant look-out in all directions for smokes, and he should be furnished with a watch, pencil, and paper, to make a record of the signals, with their number, and the time of the intervals between them."

When smokes are to be raised "at intervals," they are made by having the green branches ready in bundles and spreading them upon the fire kept briskly burning at the appointed times. The cannon cartridge puffs can often be used more conveniently. The Indians are said to build fires in holes and confine the dense smoke therein by spreading a blanket, which they remove at proper times to make the "puffs."

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### MATCHES.

There should be carried in every kit-haversack or pannier "Wind Matches," or those so prepared with composition as to be inextinguishable by wind or rain. There should be supplied some yards of quick-match, and some prepared slow-match. Cotton string or rope make a good slow-match.

Some sticks of "prepared punk," the common firing match of pyrotechnists, should be among the stores.

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### THE USE OF ROCKETS FOR SIGNALS.

The advantages to be gained by the use of rockets are dependent upon the fact that they attain great elevation, and are sometimes visible when signals, made on the ground, would be unseen. Rockets, also, readily attract attention. They are visible, under favorable circumstances, at about the same distance as the Coston lights. They are not reli-

able for signals at a greater distance than eight miles, unless they are used simply with reference to their number, as exhibited one at a time, two at a time, three at a time, and so on, to indicate different messages; or when made to throw out clusters of stars of a single color, as all white, or all red; when, by the mass of light thus given, they become visible at longer ranges.

The plan of Chronosemic Signals affords, by far, the best mode of using rockets yet suggested.

When rockets are used for Chronosemic Signals, time is taken from the explosion of each rocket. The rockets may be fitted for firing either with very quick fuses, so that no perceptible time is lost in the ignition, or with a correctly timed fuse. A number of rockets may be connected, the fuse extending from rocket to rocket, and the lengths of fuse between the rockets so regulated as to cause the firings at the proper time. (Plate XXII.)

A yard of common quick-match burns twelve seconds. Time-intervals may be arranged by proportioned lengths. If the match is moist, it will not burn regularly.

The visibility of rockets is apt to be overrated by inexperienced signalists. They cannot be successfully used in a wooded country, for the rocket rises above the trees. The observer, at the communicating station, must also be above the trees, or he will not be able to see it.

Sometimes, when clouds hang low, rockets throw out their stars above the clouds, and thus become invisible. They are liable to many mischances which do not attach to less complicated articles. There are, however, many occasions for their use, and every well-equipped signal party ought to be provided with them. The rockets furnished by the Ordnance Department of the Army are generally made with the sticks attached, or to be attached, by wires. A preferable plan is that introduced into this country by the Messrs. EDGE, of New York, and since made a part of

the plan in the construction of all the signal-rockets for the use of the Signal Corps. (Pl. XXII.) The rockets of this device have fastened, on one side of the case or head, a small pasteboard tube. This is called a "sling," and is for the purpose of attaching the stick to the head. The rocket-stick is made to taper slightly at its extremity. The rocket-heads and rocket-sticks are carried separately, until it is desired to use the rocket. Then, to attach the head to the stick, the tapering extremity of the stick is thrust into the tube or "sling," with a moderate pressure. It will be found that sticks thus fastened adhere with sufficient strength for any purpose of firing. The gain in the ease of transportation, and in the readiness with which the rocket can be prepared for firing, is very great. When rockets are to be transported for great distances, the heads ought to be packed in strong boxes; carrying, say, fifty heads to a box. The sticks should be packed by themselves, in packages of fifty sticks to a package, and wired or bound strongly on the outside. These packages should be made up of smaller packages, in which the sticks are bound together by sixes. The sticks are thus ready for distribution for use, as soon as the main package is open. When rockets are to be transported rapidly, for short distances, as to accompany the march of a column sent for any particular purpose, or to be carried to any particular station, the heads may be carried in panniers, upon pack-animals; or a few heads may be carried, rolled in a blanket, behind the saddle, or in a haversack, or in any kind of a pouch or bag. Care should be taken to arrange that the heads may be so bound down that they will not be shaken or rubbed violently together in the transportation. For the want of this precaution, rockets are often found useless on arriving at the firing station. Rocket-sticks should always be carried detached from the head, and bound together in little packages; as of four, or six, or eight. The strength gained by this union, renders

it almost impossible to break them. These packages can be easily carried by men on foot; or, by mounted men, they can be carried over the bow of the saddle, or with the lower part of the package resting on the stirrup, or in other ways which will suggest themselves. When such packages of sticks are to be carried on a pack-saddle, they should be attached lengthwise of the animal. If carried crosswise upon the saddle, the ends may come in contact with other objects on the road. The signalist should always personally inspect the packing of rocket heads and sticks, before starting on a march. He should notice particularly that the paper stretched across the "choke" opening of the rocket, and which covers the match, is unbroken. If the rockets are made with star-heads, he should see that these are not damaged. He should take care that there are packed in his kit slow-matches or port-fires, and extra quick-matches, to be used in case the matches attached to the rocket fail. It is well to carry extra stars of all kinds, when they can be obtained. A damaged rocket can often be refitted by inserting new matches, if the match has been lost; and by refitting the heads with stars, if those originally placed have been broken or are missing. To rematch a rocket, a piece of quick-match must be doubled upon itself, so as to consist of two stems, and be then thrust far into the "choke" orifice of the rocket. It can be carried well into the body of the rocket by a piece of wire, or a slender stick. To refit a rocket with new stars, it is only necessary to remove the cap upon the upper end, and to fill the cavity in the tube, which will be thus exposed, with stars of whatever color. A little mealed powder should be sprinkled among them. These stars may then be retained in place by either restoring the cap, or with a wad of paper loosely placed above them. The rocket will ascend and throw out its stars equally well without or with the cap. Any rocket, of suitable size, may be made to

show a bright flash at a great elevation, by removing the head-cap, and attaching in its place a half-pound cartridge of powder: the powder to fill the star-cavity. It will be ignited when, at the end of its flight, the rocket explodes.

### OF FIRING ROCKETS.

When rockets are to be fired, the sticks must be attached: the rocket placed upright as upon a frame, or against a fence or post, the paper covering the "choke" orifice is broken, and the firing match, which will then be found, is drawn out to a length of two or three inches. The rocket is fired by igniting this match. If the night is damp, the match ought to be exposed only a moment before the rocket is fired. If several rockets are to be fired in succession, it is well to prepare them all at the same time, and to have them all stood upright, but each separated from the other, at a distance of at least six feet, else one may ignite the other accidentally. In firing for Chronosemic Signals, one rocket ought to be kept ready upon the frame and in reserve, to be fired in place of any other that may fail.

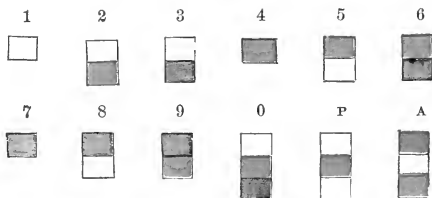
If a rocket misses fire, it is to be taken from the stand and laid on the ground. Its place is at once supplied by a similar rocket, fired in its stead. The failing rocket is laid on the ground, in order that, if it has only hung fire and should afterward ignite, it may not disarrange the signal shown. Extra rockets should be always at hand, to supply the place of the failing rockets. All rockets near the firing station should be kept in a horizontal position. If the wind blow freshly from any direction, the rocket to be fired should be inclined slightly against the wind. Some pyrotechnists direct the rocket to be inclined with the wind. In default of a stand, or objects against which to place the rockets, the rocket may be rested against the hand, held extended at arm's length, and be thus fired. Experienced

pyrotechnists find no difficulty in firing in this manner. The rocket should rest lightly against the hand, which should touch it on the case, and just above the "choke" orifice. (Plate XXII.)

### COMPOSITION FIRES.

Composition Fires are pyrotechnic compositions which burn with great intensity of light and of color. The colors, red, white, and green, are found to be best suited for signalling. A very ingenious and convenient mode is as follows:

#### COSTON'S COMPOSITION TELEGRAPHIC NIGHT-SIGNALS.



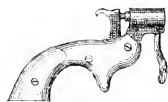
*Explanation.*—These signals, prepared in the form of cartridges, are burned from a holder. The signals, while burning, will show the colors and correspond with the numbers above indicated.

*Directions for Use.*—When it is desired to communicate with a certain distant point, first use the P (preparatory) signal; and if answered by the A (answering) signal, it shows that the preparatory signal was seen. After which, place in rapid succession, on the holder, the numbers desired to be communicated; for instance: if the numbers selected should be 726, the No. 7 is placed on the holder and ignited, which





# PLATE XXIII.



Signal Pistol.



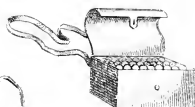
Signal Lights.  
Composition fires



Signal Pistol Charged  
with composition Light.



Signal Pistol Fired



Belt box open showing  
Signal Lights Contained



Telescope uncapped & opened for use



Strap & case for  
Binocular Glass.



Telescope closed and  
capped for transportation.



Wand for practice.



Instruction in Signaling  
practice with wands.

will, of course, show a green flame; as soon as the light is out, immediately replace it by No. 2, which will show a white succeeded by a red flame; and then replace with No. 6, red and green. If any further combination of numbers is to be signalled, before receiving an answer an interval of not more than three-quarters of a minute should be taken. Should this interval be exceeded, an answer may be returned.

The person stationed to note the colors telegraphed to him should be cautioned against looking at the brilliant flame of the signals burning near him, as thereby the eye is unfitted to discern distinctly the colors of distant lights.

To ignite the signal, apply a lighted match-rope or port-fire.

An intense light may be made by mixing magnesium in powder, with ordinary pyrotechnic composition. Two or three pounds of this mixture may be fired at once to attract attention—as of a beleaguered garrison. Magnesium may be added to any pyrotechnic compound.

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The Signal Cartridges of the Signal Corps of the Army, prepared upon the principle of the Coston lights, are fitted to be fired by the explosion of the percussion cap upon a signal-pistol. (Plate XXIII.) A needle-signal pistol has been devised. With this, the light, properly prepared, is ignited by friction of a needle driven by the lock, upon the principle of the “needle-gun.” The colors upon the cases of these cartridges indicate colors which will be shown, and the order in which they will be shown, upon the ignition of the signal-cartridge. In addition to this, the cartridges are sometimes marked with a number, which number is supposed to be indicated as often as a cartridge of that kind is fired.

With the instructions preceding in this Manual, codes of messages to be shown by these lights can be formed almost without limit.

Nor does it matter whether the signalist be supplied with the ten different kinds of lights, one for each numeral, or with fewer sorts.

Let it be supposed, for instance, that he is allowed but three sorts—as red, white, and green. He designates the red as one, the white as two, the green as three; and he knows that to signal any combination of ones, and twos, and threes, he burns the proper lights, one after the other rapidly, until he has shown those lights which indicate that combination.

He has now only to form a code of messages of which the indices shall contain only three elements, no matter how great may be the number of places in any index.

By referring to the table of reference, page 30, it is found that, with three sorts of lights given, he can indicate nine messages, burning only two cartridges for any message; he can indicate twenty-seven messages, burning no more than three cartridges for any message; he can indicate eighty-one messages, burning only four cartridges for any message; and so on to any desired extent. It is very rare, that for any purposes of temporary communication, a greater number of messages than the sum of all these would be required.

If, to continue the illustration, the signalist is furnished with four lights—as a red, a white, a green, and a red-white—then his code should be constructed, the indices being the arrangements that can be made with four elements.

In this case, there could be indicated sixteen messages, two cartridges being burned for each; sixty-four messages, three cartridges being burned for each; two hundred and fifty-six messages, four cartridges being burned for each, and one thousand and twenty-four messages, five cartridges being burned for each; and so on. If the signalist

was limited, as he sometimes might be, to two sorts of cartridges only, as, say red lights and white lights, it is evident that, following the same principles of arrangements, he could still form codes by which to indicate any number of messages. It will be necessary to burn a greater number of cartridges. Thus with two sorts given, there could be indicated four messages, burning two cartridges for each message ; eight messages, burning three cartridges for each message ; sixteen messages, burning four cartridges for each message ; thirty-two messages, burning five cartridges for each message ; and so on.

In preparing codes for messages to be indicated by composition lights, or cartridges, it is desirable to so arrange the codes that all the indices shall have the same, and that a preconcerted number of places,—that is, that all the messages shall be indicated by burning for each two cartridges, or by burning for each three cartridges, or other agreed number. It is the object of this rule, that the observer, noting a signal made, may be certain, when he has seen a signal showing the proper number of cartridges burned, that it is a signal made by friends, that it has been completed, and that he has seen the whole of it. This lessens the chance of error. For instance, suppose that it has been agreed that a code shall be with indices of three places. Now, if the observer has a signal shown with but two cartridges burned in succession, he knows that the signal is either not meant for him, or that he has failed to notice one of the lights, or the light has failed by some accident to be shown. He would wait for the signal to be perfectly and properly shown, or he would signal for its repetition.

When the exact number of cartridges burning in their proper sequence has been shown, there is little chance for error.

In the preparation of codes for signals with composition fires, there should always be arranged “a preparatory sig-

nal," which means: "Are you ready?" "Do you see me?" and an "answering signal," which means: "I am ready;" "I see you;" a signal "to repeat," which means: "Repeat your last signal; it is not seen, or it is not understood;" and a signal to signify the correct receipt of the message, or "Signals seen or understood." It is a very good plan, when the messages to be conveyed are not numerous, for the receiving station to indicate that it has seen and correctly understood the signals shown, by repeating in its turn precisely those signals shown at the sending station. The sending station should never fail to require from the receiving station the acknowledgment that the signals sent have been seen and understood; and the receiving station should be equally particular to promptly make such acknowledgment. At both stations, every article to be used in the transmission of signals should be carefully inspected, some moments before the time for signals, to render certain that there will be no failure at the moment of lighting; that the lights are perfect, caps good, and pistol clean and in good order.

Extra lights and caps ought to be laid out, to be used instantly in case of the failure of others. It is well to blow strongly into the tube of the pistol, to clear it, after the burning of each cartridge. In the same way, precaution should be taken to examine the matches, etc., if the cartridges are to be ignited by port-fires. When it is practicable, an assistant should stand ready, to hand quickly extra cartridges, caps, or other articles that may be needed while signals are making. The time which may be allowed between the burning of the separate cartridges, from twenty to forty seconds, will generally be ample for all preparation, without any haste. The intervals of time between the burnings ought to be made as nearly equal as is possible. The signalist, going to the station, should be provided with extra lights and material, to be used in case of accident. Composition fires, of full size, can be distinctly seen, with the

naked eye, on nights ordinarily clear, at distances varying from six to ten miles. They afford one of the most convenient and rapid means for transmitting messages by preconcert. By posting signal lines with the stations in view of each other, knowledge of an enemy's movements, or other information, may be transmitted over long ranges of country, with very great rapidity and an almost absolute certainty. Often, where the messages to be transmitted are not numerous, intelligent privates, posted on these stations, will discharge the duty fully as well as officers, whose services may not be attainable. The instructions for their use can be made so simple as to require but little effort for their comprehension, while the discharge of the duty requires nothing but fidelity and watchfulness. When lines of stations are established, care should be taken that each station be supplied with copies of instructions precisely alike, and with exactly correct codes of signals. These instructions and codes, plainly written, should be compared with each other before they are issued.

There must be indicated in the code, with very great precision and fulness of explanation, what color of cartridge is to be used for each number, letter, or mark appearing in the indices of the code, and the intervals with which they are to be fired.

A code may be formed, for instance, as follows:

#### EXAMPLE OF A CODE.

Burn for "Attention"—a red light.

" — "Ready to receive"—a white light.

" — "Assent"—two green lights in succession.

" — "Repeat"—a white light and a green light.

*Message Signals.*

The following colors stand, as often as they are shown, for the numbers opposite each :

White—	stands for—	1.
Red —	“	—2.
Green—	“	—3.

Intervals between lights to be not more than twenty seconds.

## SIGNAL LIGHTS.

- 12. A white, a red—Enemy coming down the river.
- 21. A red, a white—Enemy at Harper's Ferry.
- 22. A red, a red—Enemy advancing.
- 11. A white, a white—Enemy retiring.
- 31. A green, a white—No cause for alarm.
- 33. A green, a green—All well.
- 32. A green, a red—...Etc., etc.
- 13. A red, a green—.....
- Etc., etc.

All message signals consist of two lights each. Each light must be noted down as it is seen.

## CARE OF SIGNAL APPARATUS.

The senior officer on a station, or with any party, is primarily responsible for the condition of all the apparatus; and it is his duty to see, each day, that the whole equipment is ready for instant service. Officers should be held responsible with their commissions for the proper discharge of this duty; and each set should be placed in charge of an enlisted man, who will be held responsible with his pay



for its condition; precisely as, in the case of other branches of the service, each soldier is responsible for the proper condition of his equipments.

Whenever particular sets of apparatus are to be habitually used for signals in the field, that apparatus should be cared for with scrupulous exactness. Defects in the apparatus not only annoy the signalist himself, sending the message, but they more annoy the person to whom messages are, for this cause, imperfectly sent. A courteous regard for the rights of others ought, of itself, to prevent any officer from thus inflicting on another the consequences of his own carelessness.

Neglect of apparatus is a matter for discipline. Daily inspections should insure that the telescopes, etc., are clean and in perfect order. If the common field-sets of the army are to be used, the torches must be each morning cleaned: they can be scoured with ashes, or washed with turpentine. The torch-wicks must be examined, trimmed, and renewed. They must be made tighter by adding new threads to them, if they seem too loose; and this can be judged to be the case, if there is even a slight dropping of turpentine: or they must be loosened by lessening their size, if so tight that the fluid cannot readily flow through them, to feed the flame. The torch screws and catches must be examined, and the torches prepared, in every part, for the labor of the coming night. The torch is not to be filled, however, during the day. The flags must be examined, each by itself. If there are rents or loosened ties, they must be repaired. If the flag has become soiled by usage, it must be well washed and dried. A clean-washed flag is seen and read with ease, where flags dusty and dingy with use are invisible. Signal-flags in use should be habitually washed each week. The joints and bands of the staff must be scoured and tightened if loose, or carefully fitted again if any shifting or springing has been noticed. Rivets must be re-clenched, if started. The staff itself ought to be cleaned and scraped.

The copper cans and the service canteens are to be examined and filled. They must be cleaned; and if there is a leakage, it must be stopped. Steps should be taken to turn into the depot any article thus damaged. If the leather in the top screws of either the canteens or cans is worn or loosened, it must be replaced. The carrying straps and buckles of the canvas case and of the canteens must be examined, and the binding-straps counted, to render certain that none are lost. All leather parts must be cleaned, and kept pliable with neatsfoot or castor oil.

When the apparatus is to be packed, the torches must be perfectly emptied of any fluid they contain, or the flags and other portions of the set may be ruined by its leakage.

If signal-disks are used, it is to be seen that they are kept perfect and clean, the handles well attached, and the disks stored where they will not be damaged.

Where there are portable Semaphores, it must be noted that the arms are not damaged, and that they are well colored; that the ropes and pulleys are in good order, and that the joints work smoothly.

Where sets of flags, as naval signal-flags, are kept on hand, they should be overhauled at least once a week.

Lanterns are to be inspected, to see that the glasses and metal work are scrupulously clean—the handles strong and safe—the sliding parts and springs in good order, and that no part is loosened or in such state as will prevent any required signal from being instantly shown. Where there is a “flashing slide,” or other “flash apparatus,” its working should be practically tested each day. The lamps should be carefully trimmed before sunset.

Especial attention must be given to the care of Pyrotechnic Compositions—Signal Cartridges, Composition Fires, Rockets, Signal Bombs, etc.

These should be carefully stored in waterproof chests or

pouches, and sedulously guarded from the moisture they are so apt to attract and absorb.

They must be aired and dried whenever there are indications that this is necessary.

Whatever articles of this description have been carried by any party going out on temporary service, should be at once restored in the store-chests upon the return of the party to camp.

Nor should any such articles be permitted to be out of the store-chests in camp, unless for some immediate use.

They should be at once repacked, when the necessity has passed.

The officer in charge should satisfy himself of the condition and storage of these articles by personal inspections. And he should see that they are perfect or at once repaired, that matches, fuses, etc., are in good order, and the article conditioned for immediate use.

The senior signal-officer is further charged with the duty of keeping on hand at all times supplies for general use—as burning-fluid, wicking, matches, spare sets of apparatus, telescopes, cloth for flags, rope, and such other articles as experience has shown necessary for the best service of his party.

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## TRANSPORTATION OF APPARATUS.

A signal-officer, mounted, and serving with troops, ought never to permit himself to be, at any time, without his glasses and signal equipments, his compass, message-book, and map. No matter for what purpose he is moving, or how little chance there may seem for his particular duty, the occasion may, at any instant, arise when the power to communicate a few sentences would be invaluable. On reconnoissances, or when examining a tract of country for

signal points for stations, this precaution is to be always observed. And in such cases he should have carried by his escort, rockets, signal-bombs, etc., for Chronosemic Signals.

On marches, the whole set of apparatus, packed, may sometimes be carried in an ambulance. This ought never to be done, however, unless the officer is dismounted and travelling in the ambulance. A set of panniers with rockets, bombs, composition fire, etc., should be carried in the vehicle.

The following is a convenient way in which to carry the standard signal equipment on horseback. The large or first joint is taken from the set, and is not carried: the three other joints of the staff, jointed together, are carried like a lance, the butt of the staff resting in a lance-socket at the stirrup; the staff being carried on the right side of the body of the horseman, mounted, and slung behind the right arm, with the arm passing through the leather strap or lance sling which accompanies each set. Or they may be carried strapped together at the pommel of the saddle. The torches, flags, and the remaining articles of the signal set, neatly rolled together, and placed in the canvas case, are strapped across the horse, either in front of or behind the saddle. This package bends easily to fit itself to the saddle. The canteen is carried on the left side of the horse, strapped close to the saddle, and the bottom of the canteen is strapped down, so that it can have no motion. The haversack is on the right side of the horse.

To carry a flag flying, when mounted, as in changing stations, or at any time when it is desired the progress of the party should be watched, attach the four-foot flag to the staff; and have the staff then carried, slung as a lance, as described above; or let it be carried upright, the staff held in the hand, and the butt placed in the lance rest.

Disks may be carried tied together in pairs, face to face,

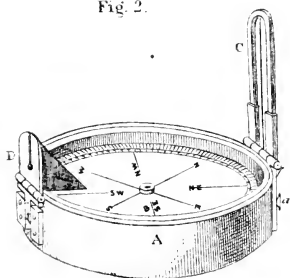
# PLATE XXIV.

Fig. 1.



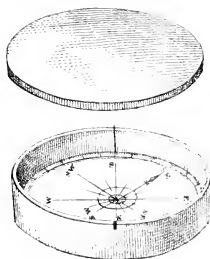
Transportation of Apparatus.

Fig. 2.



Prismatic Compass

Fig. 3.



Pocket Compass.



and fastened flat upon the side of the saddle or under the stirrup strap.

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Lanterns can be carried in pouches arranged like saddle-bags, and fitting behind the saddle. They must be carefully wrapped, and so tied in the pouch and down upon the saddle that they will have no motion.

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Signal Bombs, Rockets, Composition Fire, etc., can be carried in pouches behind the saddle, or in panniers upon a pack-animal. In either case they must be so packed and bound that they cannot be shaken or rubbed together. A dozen or more shells can be carried in pouches behind the saddle. The signal-mortar can be strapped between the pouches.

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Portable Semaphores and the heavier parts of the equipment and supplies must be carried on wheels.

Portable Semaphores may be borne for short distances in the hands of men.

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It must be the study of the signalist to reduce his equipment to the smallest weight and bulk, and to fit it to be transported with the greatest rapidity.

In the transportation of signal apparatus or supplies, etc., either on land or on shipboard, it should be so arranged that easy access may be had at any time to any of the boxes or packages containing them.

## TELESCOPES, AND THEIR USES.

The Telescope of the Signal Corps pattern has been determined by experience as the best for general uses. These telescopes are of about thirty powers. They have a focal length of twenty-six inches. The tube is cased in leather, in place of wood or metal. The draw is of four joints, bronzed black, in order that there may be neither glitter to attract the enemy, nor glare to disturb the eye of the observer. Leather caps are fitted over both eye and object glasses, and the whole is supported by a strong leather strap, long enough to pass over the shoulder, and connecting the caps and glass in such way that there are no loose parts. (Plate XXIII.) This glass is strong and portable. It has power sufficient for any ordinary use, and is of a size to be conveniently handled. It is habitually worn slung over the shoulder, by the signal-officer, wherever he may be, in the field.

At permanent stations, the largest and most powerful glasses, mounted upon stands, and with accurate machinery, compasses, scales, etc., may be used.

The varieties of pocket-glasses may be used at distances of from five to ten miles. A glass known as the carbineer-glass is not larger in diameter than the finger, and may be carried in the vest pocket.

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Binocular-glasses (marine-glasses) have, with a low magnifying power, an extensive field of view, and give much light. They are for use in observation of extensive movements, where large tracts of country must be taken in one field of view, or in sweeping the landscape in view, to find the tents of the enemy, his wagons, etc., or other objects to be afterward more closely examined with the telescope.



They are employed on ship-board, or in boats, where the rolling motion interferes with the use of the telescope. They are used for observations to be made on horseback, or in hasty examinations made on foot or in trees, and generally for all observations not critical, or those to be made under circumstances where the telescope cannot be conveniently handled. The marine-glass ought to be held by both hands when in use; and to steady it, the arms ought to be kept close to the body. In following a moving object, to keep it in the field of view, the head ought to be turned with the glass. For reading signals at short ranges, as, say up to five miles, these glasses are better than the telescope. Signals have been frequently read with glasses of this description at the distance of ten miles.

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Telescopes ought never to be allowed to fall into the hands of the enemy. Officers, on dangerous stations, should conceal their glasses when not in use. When a glass is to be hidden for precaution, the object-lens, or one joint of the telescope, should be hidden separately from the body of the telescope. A single joint or one lens is so small an object, that it can be concealed almost beyond the possibility of discovery. If an officer is in danger of capture, and there are no means of concealment, the telescope-glasses must be shattered or rendered worthless rather than surrendered.

To adjust a telescope to its proper focus, view with it some object with well-defined outlines, at a distance of about half a mile, lengthening or shortening the eye-glass joint until the object is seen with the sharpest distinctness. To adjust a glass at night, fix it upon some brilliant star.

Glasses which are to be used in the field, should have plainly marked on one of the eye-glass slides a focus-mark, so that they may be adjusted at any time without an especial adjustment in every case.

Telescopes, the object-glasses being equal in size, diminish light, as a general rule, in proportion as their magnifying power is great. The most powerful glasses are, therefore, to be used for minute observations on the clearest days, or when there is a strong light upon the observed object. When the light is fading, or there is little light upon the observed object, the clearer view will be had with glasses of large field and low magnifying power. When telescopes are fitted with a double adjusting focus, the short focus is to be used when the light is dim, the long focus when the light is strong.

The following is a simple method by which to estimate approximately the power of a telescope.

When the object-glass of a horizontally placed telescope is turned toward the light, a luminous point or spot appears on the eye-glass. The diameter of this spot must be carefully measured. Measure then the diameter of the object-glass. The power of the glass is that number given as quotient when the diameter of the object-glass is divided by the diameter of the luminous spot. Thus if  $x$  = diameter of object-glass, and  $y$  = diameter of luminous spot, then  $\text{Power} = \frac{x}{y}$ .

A mode by which to test defining qualities of glasses is, to examine with them lettered signs or printed letters at a distance. Preference is given to that glass by which the smallest lettering is read at the greatest distance.

When the atmosphere is loaded with moisture, the object and other lenses of the telescope being cold, sometimes condense it, and become covered with a thin film or mist; this is especially liable to happen at night. It should always be suspected when, while the night seems clear, and lights can be seen with the naked eye, they are seen with difficulty through the glass. To remedy this, the glass ought to be thoroughly warmed at a fire or with a lamp—care being

taken that it is not overheated—and made so warm as to retain its heat while it is being used to receive messages. The eye-glass of the telescope is sometimes obscured by the moisture of the breath condensing upon it while the eye is at the glass; this ought to be carefully guarded against.

Old newspapers furnish the best material with which to clean lenses. The pieces to be selected should be free from grit or any thing to scratch the glass. Soft paper is better than chamois-skin. The telescope glasses ought to be kept scrupulously clean.

If the telescope is to be carried in the rain, a leather cap must always cover the eye-piece end. Without this precaution, the glass will be filled with water, and may be ruined.

It should be practised to use both eyes open at the telescope. This can be readily done. The method is more comfortable than to use but one eye, and by it is prevented much of that weariness and injury to the eyes that often follow if they are overstrained, or too much labor is thrown upon them.

When reading messages through the telescope, or observing any object intently in bad weather, cover the head with a blanket, or the cape of an overcoat, or any dark covering, extending this covering over all the telescope except the object-glass: particularly do this when exposed to a dazzling light, or the sun's heat, or in windy weather. The covering shuts out from view all objects near the observer, and thus enables the faculties to be concentrated; and, at the same time, it protects the eye from the disturbing light, the winds, particles floating in the air, etc.

To find any small object, as a signalman or flag near any known position, or to fix the telescope upon it, mark, with the naked eye, some prominent landmark, or object near which the smaller object is supposed to be, place the tele-

scope carefully adjusted in rest, then sight over the glass upon the marking object, as sight is taken over a gun-barrel; if the eye, the object being thus covered, is now placed at the eye-glass of the telescope, the prominent or marking object will be found in the field of view. It will be easy then to scan the country near the marker until the smaller object is found. This practice is often necessary at night, when only a point of light is seen, far off through the darkness, and the telescope must be turned upon it. When the compass-bearing of the object to be sought for is known, the telescope, adjusted and placed in rest, may be aligned by a line drawn with the proper compass-bearing. Commencing then with the view at the horizon, the telescope is moved slightly from side to side, taking in, each time, fresh fields of view a little nearer the observer, until the whole country shall have been observed from the horizon to quite near the station. When the general direction only of an object can be given, and it is to be sought for, the whole landscape in that direction to the horizon is to be divided into sections by imaginary lines, the limits of these sections being bounded between visible landmarks through which the bounding lines are supposed to pass. Each section is then to be scrutinized, little by little, until the glass has been passed over every spot. The search can hardly fail to be successful. It must be systematic.

Practice should be had in the use of the telescope, held in the hands without rest, in rapidly bringing objects in the field of view, and in the habit of examining an object or point thoroughly, yet quickly. Observations can often be made with such rests as the shoulder of a man, over the back of a saddled horse, or with a cane resting on the ground and held in the hand that steadies the telescope. Very great quickness in the bringing of objects within the field of view can be soon acquired. The eye becomes educated to a remarkable keenness of vision by continued prac-

tice. When observations are made with the telescope, or when messages are being received by it by signals, nothing must be taken for granted, and nothing considered as seen, until it has been positively in view, and so clearly as not to admit of doubt. Never presume to anticipate what signals will follow from those already made. A signal must never be considered or announced as read until it has been actually seen. Carefully watch the communicating station until the last signals are made, and be very certain, before ceasing to watch, that the signal for the end of a message has been distinctly given.

The officers at each signal-station must take care that a lookout, through the glass, is kept at each station so constantly that no signal can be shown, at any time, at the communicating station, for more than two minutes without receiving an answer. For this reason, when not at the glass himself, he will cause his men, or any one on duty at the station, to keep a regular "glass-watch," assigning the men by turns, and fixing particular hours for each, that responsibility for neglect may be easily traced. These details will relieve each other every two or four hours, day and night. The watchman on duty must be seated at the glass; and before assuming his station must, with the aid of the soldier last on duty, make certain that he knows the exact position of the observed station, and that it is plainly in the field of the glass. This precaution is particularly necessary at night, when the least movement of the glass may have thrown the station out of view. All landmarks being then invisible, there is nothing by which to detect the error; and signals may be long shown in vain at one station, while the glass, not bearing upon them, is attentively watched at the other.

When a signal station is to communicate with two or more stations, a telescope should be firmly fixed bearing on each, and so far apart, that the reader at one will not be

in danger of disturbing the reader at the other by his movements. At permanent stations, the fixed telescopes should not be removed from their supports when signalling has ceased for a time, unless it may be necessary to clean them; but they should be kept in position carefully covered, to protect them from the weather.

If, for any reasons, telescopes have not been fixed bearing on the communicating stations during the day, or have been moved from their stands, they must be returned and adjusted before dark. After dark landmarks are lost to view, and distant stations are discovered with difficulty. The glass must have in its field the exact point at which night-signals are to appear, and must so remain, properly sheltered, until morning. The neglect of this care often causes much trouble.

The telescope should always, when possible, be first placed in rest and properly adjusted in some sheltered or shaded position, and in one as convenient as is attainable, before communication by signals, either in the day or at night, is opened; for, after communication is opened, important messages may come so rapidly, that the glass cannot be abandoned, and the station must be worked for hours with much of discomfort, and even of suffering, on the part of the reading officer.

The glass-stand or support may be a heap of stones, two saddles lashed together, a temporary tripod of sticks, a post, a stump, fence, anything furnishing a steady rest. Blankets, thickly folded, or any cloth, as an overcoat, a cushion, or a pillow, placed under the glass, almost entirely prevents vibration. Stones, or other heavy bodies, ought to be placed on and about the glass, in order to secure it in its place and to steady it. The brass telescope-holder, fitted to screw into trees or other wooden supports, is very useful. Trees, having branches and leaves, are apt to be shaken by the wind; for this reason, a fence corner, a stump, or solitary



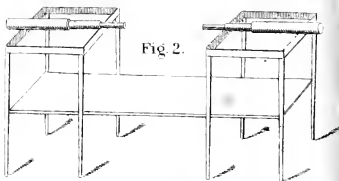
# PLATE XXV.

Fig. 1.



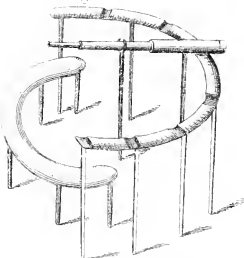
Object viewed through  
a scale glass.

Fig. 2.



Telescope Rest for use in the field

Fig. 3.



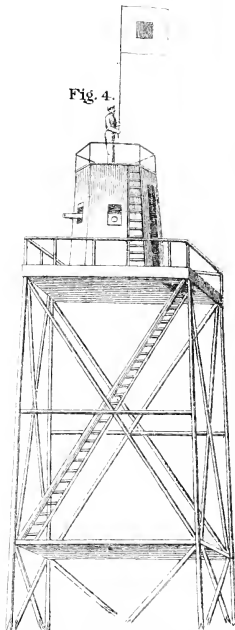
Telescope rest to use one Telescope  
for observing several points.

Fig. 5.



Telescope resting upon a folded blanket  
and weighted to secure steadiness.

Fig. 4.



Plan of Permanent Station on a house  
or tower



post or rock should be chosen in preference. It is important so to construct a support, as to allow the person at the glass a comfortable position while reading, and it should be firm enough to withstand any ordinary gust of wind, or other slight disturbing cause. At a post or fixed station, it is well to construct a permanent glass-stand, and to shelter it with a good tent or sentry-box.

The plate exhibits plans for glass-stands. (Plate XXV, Figs. 2, 3, 4, and 5.)

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### SCALE GLASSES.

Telescopes may be prepared as scale-glasses for estimating distances, without in any way impairing their usefulness for other purposes. A micrometer scale, the distances between the lines of which have been carefully estimated, is engraved on an additional glass so fitted that it can be placed within or removed from the tube of the telescope at the option of the observer. When this glass, so engraved, is adjusted in the focus of one of the lenses, it becomes visible to the eye of the observer placed at the eye-piece, while there is at the same time had, in the field of view, the object it is desired to view, and the distance which is to be estimated. The principle upon which the scale is formed is, that the angle subtended by the rays from any object meeting at the eye is in exact proportion, greater or less, as the object is near or remote. The distance being known at which a certain visual angle is subtended by any object of known height, the distance at which that object is, its location being changed, may be estimated by the measurement of the increased or diminished angle it then subtends. The height of a man—or five feet six inches—is generally assumed as the unit of measurement. Upon the engraved scale before mentioned, one line is marked as the base-line. At right angles to and joining this line is a smaller line, by

which the base may be distinguished from other lines. Other lines, more or less in number, appear engraved parallel to and above the base-line, at distances carefully estimated. The field of the telescope, the scale being adjusted, appears as in Plate XXV, Fig. 1.

For measurement, the telescope is adjusted until the feet of the man to be viewed through it, or the base of any object, if something inanimate has been selected, are brought in the field of view to apparently rest with precision upon the base-line. The first line upon the scale above the base-line then marks the point upon the glass to which the head of the man thus viewed should seem to reach, if he is distant, say five miles. Now, if the man is at a less distance, his figure will seem to cover a greater space, and his head reach higher upon the glass; so the second line on the scale above the base may indicate the point his head will seem to reach if he is distant four miles. The next line above may be the scale-point, if he is distant three miles; the next, if distant but two miles; and the next, when he is one mile distant. The intervals between the lines may be graduated into smaller intervals. And there may be a scale by which to measure fractional parts of a mile, as hundreds of yards, etc. With proper care, distances may be in this way very fairly estimated.

To use "scale-glasses" successfully, the telescope must be perfectly at rest. The slightest tremor interferes with the accuracy of the estimate. An additional difficulty is found in the fact that, at great distances, the finest scale-lines cover too much of the viewed object. These difficulties can be lessened by practice only, and the thus acquired skill in using the glass. Very useful approximations to exact distance can, however, be easily made.

Glasses of high magnifying power have been scaled in this way to determine considerable measurements, as to estimate by the height of a man at ten miles distance.

These scales may be used to measure the face of a work—to determine its height and its distance; the distance of batteries, ships, etc., and of marked points on the field of battle; or the distances at which bodies of troops are moving. The width of rivers can be determined. The range of objects at which artillery is to fire can be had, so as to fix the proper elevations and the length of fuses. Lines for rough surveys may be run. Distances may be measured for maps. There may be had many other estimates, the utility of which will suggest themselves to an educated officer.

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### POCKET COMPASSES.

The pocket compasses used by signal-officers, are lettered after the plan of a surveyor's compass. The compass should have fixed upon its case-edge, opposite the "N," and also opposite the "S" marks, a small notch or sight, by which to take the range of any observed object.

It is generally the aim of the observing officer to give the compass-bearing of any object observed, taken from that point at which he is stationed. To use the compass, the North and South sights on the case-edge or on the compass-dial are brought to exactly coincide with the N. and S. points of the needle when at rest; then the object to be viewed is sighted at over the North sight through the South sight, if the object be southerly, or over the South sight through the North sight if it be northerly from the position of the observer. This done, the *bearing* is that reading of the compass-card which will appear directly under the "N" or the "S" pole or point of the needle, as the case may be. Practice should be had in the use of the compass before the officer is expected to take the field. The practice can be had simultaneously with that of the telescope, by requiring the student to find, with the telescope,

stations in different directions, the compass-bearings only being given; and also to report the bearings of different named objects, visible at the place from which he is practising. (Plate XXIV, Fig. 3.)

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### PRISMATIC COMPASS.

When especial accuracy is required the Prismatic Compass may be used.

In addition to the ordinary lettering of this compass, the card should show the lettering of the common surveyor's compass (Plate XXIV, Fig. 2); that is, with the westerly readings to the right of the North point, the card being at rest, and the easterly readings on its left.

This compass is fitted with a prism-sight through which the sight is taken, and a sight-vane, the vertical hair in which is, when the compass is used, to be brought to bear upon the object of which the bearing is to be had. For the purpose of taking this sight both the prism-sight and sight-vane must be raised upon their hinges to be perpendicular as to the surface of the compass. The eye then placed at the prism-glass will have in the field of view at once, the object to be viewed, the hair of the sight-vane bearing upon it, and, below upon the compass-card the direction and degrees of the bearing—which are read without removing the eye from the prism. When there is trouble from the oscillation of the compass-card, its movement may be checked by touching the card-spring, which is found on the side of the compass.

## INSTRUCTION IN SIGNALLING.

Experience has shown that as, in the Manual of Arms, the soldier must be continually drilled to maintain his full efficiency, so in the practice of signalling, a drill, regular and habitual, is needed to fit either officer or man for the duty in the first place, and then to retain them with that skill which is needed in the moment of danger and of actual war.

The instruction should commence with the study of the principles of signalling, and the theories of their general use. The pupil should be well grounded in this study before practice is entered upon. He should then be required to commit to memory certain signal alphabets to be used; and these are to be so thoroughly memorized that no signal combination will require thought to determine its meaning. The General Service Flag and Homographic Codes are to be committed in this manner. To this follows practice in the recitation-room with the "wand," a slender rod about eighteen inches long,—the class reading messages signalled by the instructor in the alphabets learned, by rapid movements of the wand; or practising in couples, transmitting messages with the wand to each other during the hours set aside for study, until each is able to read messages of whatever character signalled with the greatest rapidity of motion that can be given. (Plate XXIII.) And in this portion of the course should be included practice with codes of different numbers of elements, and signalled by different modes of position or of motion, until the pupil is well accustomed to rapidly read and make the signals. He is practised also in rapidly repeating signals as they are made to him, both according to the plans given for returning signals to the sending station, and for transmitting them as in a line of stations; and very thoroughly in sending and receiving messages by signals in cipher, using the cipher-disk, and working much

more rapidly than can be possible in the field. In proportion as this drill of the eye and mind is thorough, will be the consequent skill of the student.

The second part of the course embraces Field Practice, with the regulation signal equipment, and with telescopes. The pupil should be first instructed in the uses of the different articles of the equipment, and should be required to practically understand them, the class being well drilled by the instructor to take the proper positions for day and night signals; to make the appropriate motions and positions of flags and disks upon the word of order; to pack and unpack the equipments; to carry them from place to place; to change from day to night signals, and the reverse, and in all the duties of the flagman. They are then divided into sets by fours, and are stationed by twos upon separate signal-stations, each pupil serving in his turn as flagman and as signalist. They are here required to send messages at short distances, until the instructor is satisfied that they perfectly comprehend the duties they will afterward require from others. They repeat signals in all styles of repetition, and they signal messages in cipher, until by practice they so send and receive them with ease. In this part of the course is to be given a knowledge of the telescope, the pupil being required to explain its structure; to separate it into pieces, removing all the lenses; to clean and refit it; to adjust it by night as well as in the day, on objects near or remote; to examine with it and report minutely upon objects at a distance, as by the reading of lettered signs, the recognizing of shapes and colors of flags, etc.,—this practice being in the presence of the instructor. They are required to make cipher-disks for themselves, and to devise plans of cipher in which they will communicate. They are to be taught to correspond in cryptograms. The class is now instructed in the use of the compass; in the use of graduated (scaled) telescopes, with which they are required to estimate and report the distance

of objects seen ; and in forming rough maps to accompany reports.

With this preparation the class may be ordered for station practice on stations distant some miles apart. These stations are to be selected for them. The pupils are to be stationed by twos, required to open and keep up communication between these stations by signals, day and night ; to personally use their flags, torches, and other signal equipments ; to take care of their telescopes, and in relieving each other in turn ; to discharge all the duties of officers and flagmen upon a station ; to keep a record of messages sent and received, and to report them. At times, when they are not on duty, they commit lessons in such elementary works as familiarize them with military nomenclature and description, and they will prepare descriptive statements of works, cities, harbors, or forces indicated by the instructor. They must make written reports of information in form, as if they were reporting to a commander in the field. The class will then be distributed to different stations, which they must find, and establish themselves. They are then required to communicate with signals of different character, as signals by colored flames, rocket signals, chronosemic signals, signals by sound, by lines of signals, by simple semaphores, by flags after the manner of navies. On certain days, all messages sent must be in cipher, and all must be repeated. The officers are to be especially practised in opening and maintaining communication without preconcert, and to do this using different codes. They will be taught to rapidly break up their stations and to establish them elsewhere ; to search with their glasses for, and to find, other stations moved in the same way to new localities ; and are to be practised, under the charge of the instructor, to meet the different emergencies that may occur in the field.

The instructor, acting as superintendent of all the stations, inspects each and notes the manner in which the

duties are performed. This practice in the field is continued until the pupils are considered competent for actual service.

Whenever the corps is equipped with light telegraphic lines for field use, the officers and men should be taught the principles of electric telegraphs, and practised in the use of the different instruments, either with alphabets or with simple codes of two or three elements. They should be drilled in the rapid extension of the wire-lines, and quickly reeling them up and putting them in motion to be established elsewhere. They should thoroughly understand the modes of erecting them through forests, on pontoon-bridges, to the tops of towers, or of submerging them to cross narrow rivers or streams. The parties should be told off for this purpose by regular detail, and should be practically taught the different duties with such lines, as engineers are instructed, in all the labors of laying pontoon-bridges or constructing earthworks.

When, as in the war just passed, it is necessary to gather the class for instruction in a camp, or when its members have had no previous military knowledge, they are instructed, in the time not given to recitations or to practice, in the discipline and management of the men, the drill of cavalry with the carbine, and the rules of encampment and of scouting.

This tuition, the study of works of reconnoissance, and such other studies as may best fit them for the duties of observation, are continued whenever time offers throughout the course. Particular readings are assigned for those times when the students, being upon stations, are not immediately employed. The instruction to be given non-commissioned officers and enlisted men must be determined by their individual acquirements.



The course of study and practice here indicated should be pursued, both in the land and naval service; for, serving in either, the skill and knowledge gained cannot fail to be of value to both officers and men. The naval officer should, equally with the officer of the army, be able to direct the establishment of stations, on ship or on shore, and should know what benefits might be expected from them.

Soldiers of the Signal Corps should be drilled as cavalry, taught the use of the repeating carbine, and practised in climbing, in riding, and in marching. They serve so much in small and isolated parties, that they need the repeating arm. They should be encouraged in gymnastic exercises. Their duties, ascending mountains, establishing stations, etc., require the fullest physical development.

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## SELECTING, ESTABLISHING, AND WORKING STATIONS IN THE FIELD.

The signals used in the field, in the Army of the United States, are almost always those made with flags in motion, and the regulation signal equipment, as for the General Service Code, by two elements.

These signals are so simply and so rapidly made, and are legible at distances so great, that others are rarely needed in general service.

Signals with disks, though not visible at great distances, can be used when circumstances require. Any of the modes before described are to be employed when need be.

The occasions for these offer in communication between land and naval forces; and in emergencies, as when there is need of concealment. A station of observation is one from which observations, as of an enemy or of a tract of country, are made and reported. A station of communica-

tion is for purposes of signal communication. A signal-station may partake of both characters.

To select a signal-station, choose a point perfectly in view of the communicating station; fix the exact position in which the flagman is to stand: so arrange, if possible, that he will have behind him, when viewed from the communicating station, a background of the same color for every position in which the signals may be shown. The color of the background of a station is that of the earth or sky, against which the signals made seem to be displayed when viewed from the communicating station. To determine the color of the background, take the direction of the communicating station, and, going in front of your station, examine the position from that direction; ascertain whether the communicating station is higher, lower, or on a level with your own. If it is higher, the background for your signals, viewed thence, will be the color of the fields, woods, etc., behind and lower than your flagman. If it is lower, your background will be the color of grounds, etc., behind and lying higher than your flagman. If the stations are of equal elevation, then the background for your signals will be that directly behind the flagman. Do not presume the background is of the color of the fields near you. It may be that of the woods, a long distance, sometimes miles, behind your station. If your station is on a house or an eminence, it is still very possible that there are higher grounds somewhere behind it. The color of backgrounds is generally dark. Sky-exposure backgrounds are rare. They are not often found at long ranges on land. They cannot be had except on the exact crest of ridges or lands which bound the horizon of view from the other station, or on the precise apex of mountains, etc. At short ranges, they may, of course, be had by working on the tops of very high buildings, steeples, etc. Unless certain of the color of the background, it is safe to presume it is not the sky, and that it

is not light. It is a rule always to use the white or red flag until the color of the background is determined. The best backgrounds are darkly colored, as green fields or woods.

Place the flagman so that his signals shall appear displayed upon one of these backgrounds, if possible.

If the position is narrow, and the flagman can be placed in no other, notice whether the background is broken: that is, whether in part of its motion the flag or other signal displays on light and in part on dark ground; as if, for instance, for half its motion it shows against the trees, and for the other half against a white house; or if, for part of the motion, it shows against the sky, and for the rest, against trees.

The background being determined, the choice of flags is fixed. The color of the flag must contrast as strongly as possible with that of the background. Upon this contrast the legibility of the signals often depends.

With green or dark, or any earth-colored backgrounds, the white flag must be used. With a sky-exposure, the black flag must be used. With broken or mixed backgrounds, the red flag must be used. The red flag, or signal, is that to be generally used at sea,—as on vessels, where, in part of its motion, the flag exposes against the woodwork, or rigging, or sails of the vessel; and in part against the sky or water. It is well also to try the red flag when snow may form part of the background. For general uses, the white flag, or signal, will be found best. It can be used in nine instances out of ten.

When the stations have commenced communicating, each may announce that color of the flags, or other signals, which can be best seen at the other. This may be done as soon as communication has commenced, each station telling the other to use the white, or the red, or the black flag, or to try different flags, until the best is found.

When it is difficult to attract attention, two flags ought to be shown on the staff and in motion at the same time. If there is doubt as to the color of the background on which they are displaying, these flags ought to be of different colors; as a white and a red. When the background is certainly dark, they ought to be both white. If the background is light, dark flags ought to be used.

Sometimes, when it is very difficult to send a message from a station, as happens occasionally when detached clouds are passing the sun, and dark moving shadows are thus thrown on the earth, the messages can be sent if the signals are made only while the sun is shining on the flag. This is particularly the case so long as the sun is in any part of its course even a little in front of the flag, and its light can be reflected.

On days of sunshine, the sun shining upon a flag of course increases its visibility. The sun shining behind a flag, does not render it more distinct.

Those days are best for the transmission of messages in which the atmosphere is clear, but the sun is covered with clouds. The light is then generally diffused. It is on such days that messages have been read at the longest distances.

#### POSITION OF SIGNALMEN.

The position of a signalman, transmitting a message, must be exactly facing the point to which the message is being sent; and this must be the case, whatever the style or character of the signal he is using. Signals, of whatever description, made by the signalman, must also be shown exactly on his right and left, or they will not be clearly displayed to the observer.

To determine this exact position, a line, direct to the other station, should be sighted—as over a straight rod, for instance; and a line following this direction should be marked

on the ground in front of the signalman. A line drawn at right angles with this line, should extend on each side of the signalman. If the common signal equipment is to be used, a marking-stake should be driven on the line in front of the flagman, and twelve feet distant from him; and a similar marker should be placed at the same distance on the side lines on either side.

All signals must be made with reference to the directions indicated by these stakes. These lines must be established by daylight, if possible. The use of the markers secures the accurate displays of the signals by day, and is even more manifestly valuable at night, when the communicating station becomes invisible. The flagman has then the markers as guides to determine the direction in which his signals must be shown.

A signalman, transmitting messages, should always be placed a little in advance and to one side of the person at the glass, in order that errors made in forming any signal may be noticed and corrected.

When signals are made with torches and the ordinary apparatus, at night, the signalman must stand immediately behind the foot-light, as relates to the other station, and the flying-light be so handled that when brought to the front and lowered to the ground, as to make pause-signals, its flame, observed from the communicating station, will seem to mingle with the foot-light. When large, common fires are burning at or near the station at night, care must be taken that they are so placed as not to confound the view of the torch-signals or of other signal-lights that may be shown. The signalman must be placed well to one side of the fire and his signals must be displayed out of the line of sight from the fire to the communicating station.

The light of large fires, burning near, will often interfere, at night, with the use of the glass. The best location for the glass is, in these circumstances, in advance of the fire.

Care must also be taken to so place the signalman that the glare of the torches or lights will not interfere with the use of the telescope. It is sometimes necessary to erect a screen, sheltering the eyes of the observer, to prevent this interference.

When the color of a signal-flag, to be used at any station, has been determined upon, and the flagman has been placed, it may be yet necessary to decide whether there are any obstacles to a clear vision existing between the stations. For this purpose, view the station to which communication is to be had, from the sending station, with a telescope; first from a position close to the ground, at the feet of the flagman, and then from two other points, close to the ground—one on his right, and one on his left, at a distance from him equal to the length of the signal-staff to which the flag is attached. If, from these three points, the position of the telescope at the other station, or the whole position on which the flagman there stands, can be seen, it is certain that every signal made at the first station can be seen at the other. Similar precautions to determine this point should be had at both; such precautions are particularly called for at night. The foot-torch, lying close to the ground, is often hidden by bushes or high grass near it, and night-signals are thus made unintelligible. Signalling should never be commenced at night at any station, until, with the head near the ground and in the place at which the foot-torch will be, the receiving station has been observed, and it has been made sure that the foot-light, shown at the first, will be plainly visible there. When a station is occupied and worked during the day, all preparations for night-signals, such as filling the torches, properly placing them, determining that, when lighted, they will be in view of the other, etc., should be made before dark. When this is impossible, as when the station is first reached at night, it may be held, that any point at one station from which the fires or foot-

lights known to be at the other are visible, is in proper view from that station.

### WORKING.

When a station is found, fix the telescope steadily upon it, and keep it observed while signals are made for its attention. As soon as it is perceived that attention is gained, signal its number, or call, or answer any signals it may make.

Communicating stations should always arrange a few preconcerted signals for either day or night use. These signals should be of such character as this: "Wait a moment;" "I see you, but cannot reply;" "Cease signalling: will call you soon." This will prevent the sometimes occurring annoyance of calling a station for hours when the signals, though seen, cannot, for some reason, be answered.

When any station has signalled all the messages on hand, signals to cease signalling must invariably be made. When nothing more is to be for the time sent from either station, both will make the "cease signalling" signal. The observer, or officer, must never leave his station, or cease to watch the communicating station, until this signal has been exchanged by both stations. It must never be presumed that a station has ceased to work until it has announced this fact by signal.

Stations ceasing to work for a short time only will display a flag flying, and stationary. This is a signal that the communicating station may be called at any moment.

So long as this signal is made, an observer will be kept at the glass.

It is sometimes difficult to assure the attention of stations at unexpected hours. The force may not be strong enough for an uninterrupted watch. To guard against this trouble, it may be concerted that certain flags shall be hoisted, as on a staff; or any permanent flag, as the garrison or ship's flag, shall be wafted, or a gun shall be fired, or a rocket

thrown up, or a light burned, in case communication is suddenly required at unusual times, or is of pressing importance. When the force is sufficiently strong, and is well disciplined, these extraordinary signals will not be needed.

When a number of stations are in view from one dominant station, some preconcerted signal, as a rocket, a red light, or some peculiar flag, or torch-signal, or cartridge-puff, should be agreed upon as a signal for general attention. Upon noticing this signal, all the stations reply, and then observe the dominant station. This plan is useful when two or more stations can, at the same time, read the signals from the prominent station, and thus together receive any information to be transmitted from it.

When a number of stations are working in concert, certain fixed hours of the day and night should be named by proper authority for the especial exchange of messages; at which hours, each station may be certain that those on duty at every other station will be observant and ready for business.

All persons on duty should make it a point to be faithfully at their posts at these hours, even if communication may seem to be impossible.

Stations must be kept concealed from the enemy so far as is possible. On stations of observation solely, no flags will be shown and no persons permitted except those actually on duty. Every precaution will be taken to prevent the enemy ascertaining the purpose for which the point is occupied. When communication by signals is needed, the flag will be screened from observation, if it can be, and in any case it will be shown only while transmitting messages. All communications will be in cipher.

When two officers are assigned to duty at one station, an officer must be on the station constantly. When a single officer is on duty at a station, either of observation or communication, he must be upon the station and at the glass,



whenever the points are visible, at least once every fifteen minutes during the day and at certain fixed hours during the time of darkness, as at 11 P. M. and 2 A. M.

An enlisted man will be at all times upon the station and at the glass. He will keep a strict watch upon the points to be observed, make himself familiar with the part of the country to be viewed, and promptly notify his officer of any changes or movements he may discover. He will examine, through the glass, the communicating stations, at least every two minutes, and will report all calls. If reply cannot at once be made, he will make the signal "wait," and then instantly report the fact to the officer in charge.

The person in charge of a station is responsible for the discipline of his party, the condition of their arms and equipments, and the duties of the station.

Failure to promptly recognize and reply to calls, to transmit messages, to notice and report upon movements or other changes visible, is punished, in the case of either officers or enlisted men, as neglect of duty.

The officer in charge of any number of stations must visit each in person, and see that it actually transmits and receives messages in his presence. He may else be deceived, until a critical moment, by the incorrect report as to the working of some station which will fail in an emergency.

A record of messages ought to be kept at each station, and in it noted the date and hour of receipt or transmission of every message.

The original manuscripts of messages received at a station for transmission, must be carefully filed.

There must be, also, a record of the "watches" on duty each day, with their hours of duty, in order that any negligence may be traced.

When two stations are communicating at dusk, or when it is growing dark, and a light is shown at the receiving station, it is a signal to the sending station to use thereafter

torches, or lights, instead of flags. A light similarly shown at dawn and then extinguished, or a flag then displayed, indicates to the sending station to cease using lights, and to commence using day-signals.

While the message is being transmitted by signals, the sending station should constantly observe the receiving station with the telescope, in order that any signals there made to stop the transmission of the message may be instantly seen. The flag, or any signal, put in motion at the receiving station, is a "stop-signal." These stop-signals may be made necessary by any accident at the receiving station. For instance, the telescope there may be thrown out of adjustment, or the connection of the message may have been lost; or by numerous other causes, which will render a brief cessation of the signalling desirable. A signal to stop should be at once recognized by the sending station, and the further sending of the message must be suspended until the receiving station again announces its readiness for work. Stop-signals, of this character, cause much loss of time, and should never, unless absolutely necessary, be made by a receiving station. If part of a message is lost, it is better to receive the remainder, and then ask for the repetition of the missing portion.

In sending very lengthy messages, the precaution should be observed to cease signalling from time to time, and to inquire from the receiving station if the foregoing has been correctly received. This inquiry may be made by any signal, to which the receiver replies by the usual signal, of message understood, or by other preconcerted signal, as the case may be.

When several messages are to be sent in succession, "end of message signal" will be made after the signature of each, to be followed by the word "another:" then "end of message signal" again—after which commence with the address of the next message to be following, being careful,

always, when the messages are from *different* places or headquarters to say—"From —— (name of place) To ——, etc., etc." Without this precaution very serious errors may occur from the blending of separate communications.

Signals in the field are generally made by a signalman, who, previously drilled, makes each signal by order. These orders, "calling off signals," must be uttered with careful distinctness and precision. A pause is made after each letter combination. When a message is lengthy, a longer pause is made at the end of each sentence, to allow the sentence to be written down by the receiver. Messages must be grammatically correct, and be correctly spelled. The receiver is sometimes confounded by signals made for a word so spelled that it is not recognizable.

When stations are certainly in sight of each other, preparations for continued work should be carefully made before the transmission of official messages is commenced.

Officers will always avail themselves of proper precautions to locate their men and themselves in unexposed positions. When in an exposed position officers and men will lie down, except while transmitting messages. The flag will be kept flying, to indicate the position of the station to those who may be seeking for it, and to the other signal-stations with which it may be in communication. The flagman and the man at the telescope may be sheltered by temporary screens—as of bales of hay, fascines, sand-bags, etc.; and these can be erected in the few moments preceding an attack.

The signal staff and flag alone need project above the screen. At night, the foot-torch may be upon the top of the screen or rampart, and the flying-torch be moved relatively to it, by the staff projecting above the work: the signalman being covered.

When there is danger of capture, all messages or important papers must be destroyed.

Each signalist should have a particular signal by which

he can be known. This signal may be that for any letter or letters of the alphabet. It is known as the "officer's signature, or call." It serves to distinguish him, and any message sent by him, and for the correctness of which he is to be held responsible. By it is also designated the station at which the officer commands. A call, or particular signal, is in like manner generally assigned for each station, to distinguish that station from others.

Whenever these particular calls are seen signalled, it is known that the attention of the officers or the station is desired. The officer or the station should at once respond, making at the close of the response the same particular signal by which they are identified. The calling station or officer should give his own call or signal. There is thus established between the parties a mutual knowledge as to the parties with which each is in communication.

There are times when it will be necessary to read messages, while it is known that the signalman is facing away from the reader. In this case the messages will be easily legible, if it is remembered that each signal will appear to the reader to be precisely the reverse of that which is made by the signalman; thus all those signals displayed on the right will seem to the reader to be shown on the left, while those actually made on the left of the signalman will seem to be made on his right. Recalling this fact, it will be as easy to read the signals made at any station from the rear of that station as it is from its front.

The presence of visitors, other than official, should not be encouraged at signal-stations of any importance. In an enemy's country, visitors are generally spies, who come under various pretences, the most innocent, to gather information as to what precise points are in view from the station, in order that the enemy may avoid them; and such other items of useful intelligence as they may glean from unsuspecting officers. Visitors should never be allowed to

tamper with glasses, to examine messages, or to do any act by which the enemy may gain unnecessary knowledge.

Signal-stations should be among the last positions to be abandoned when an army is about to move, for events may happen at the last moment which will require the delay or the change of the movement, or important messages may need instant transmittal.

The chief signal-officer must exercise a discretion as to the number and position of stations to be so held.

When stations are in operation, and it is contemplated to move one of them, the moving station must inform the observing station of the fact of its change, and indicate, when practicable, the position from which communication will be resumed.

#### TO LOCATE STATIONS.

To open a line of stations across a country, first choose some prominent position, and one well visible; and here establish the initial station. Let the party assemble here. Let them, together, select a second prominent point in view as nearly as possible in the line of direction you wish to take. Upon the first station, erect some kind of beacon—as a white or other colored signal-flag; or some marked object, by which it can be recognized from a distance. Take from this first point the bearing by compass of the point selected. This second point should be one not only visible from the initial point, but one also probably in view from positions beyond it. Note should be made of some peculiar house, rock, tree, or other marked object upon it, in order that the exact place may be recognized when it is reached. At the first point, now marked with its beacon, station an officer to reply to any signals he may see, and to watch the course of the marching party. The other officers will then move, guided by compass, if need be, toward the second point selected, carrying a signal-flag

flying, in order that their position may be known whenever they come in view from the first station, and intently watched by the officer left at that station, the marching party will, from time to time, put itself in communication with the first station, so as to receive from it any direction as to its course the first station may wish to give, or any other information. It will also frequently verify its course by compass. On reaching the point chosen for the second station, a beacon or flag will be there erected, observations will be made, and communication will be opened with the first station. Points, on either side or to the rear, will be examined, to see if the second station can be better located than it is with reference to a third station to be next established. The second station will then be definitely established and marked, and an officer there stationed, as before at the first station, to watch the marching party. The point for the third station will be hence chosen, and the party will proceed toward it with the same general rules as before. These operations will be repeated in the case of each station, until the terminal station is reached. Attempts will be afterward made to reduce the number of intermediate stations by finding other and better points at which to locate some of them.

Should an officer, while establishing a line, and before it is completed, find, on reaching any station, that he is able to communicate over any of the intermediate stations between himself and the first, he will notify the unnecessary station of the fact: not, however, until he has both received and sent messages over it to some other station. Upon receiving this information, the officers at the needless station will, after notifying the stations near them of their purpose, abandon their own station and proceed to the station next in advance, or to that one which has given the information. The officer who has been temporarily stationed there will, on their arrival, join the marching party, which will meanwhile have been pushed forward to continue the line.

It sometimes occurs, in locating signal-stations, that it can be known only that a signal-station will be opened in some part of the country overlooked from a given station; or that an officer has been sent in a certain direction, and that he will try, from some point in that direction, to open signal communication.

This is to establish a "moving station." Moving stations are so called, to distinguish them from stations "fixed" by preconcert. Moving stations must always be as prominently placed as is possible: as on hill-tops; in the centre of open fields; near marked houses;—the more apt to attract attention the better. It should be kept constantly in view to always thus locate a moving station near something which is likely to attract attention from the observing station.

Officers upon fixed signal-stations will, if expecting signals anywhere, and habitually without especial orders, closely examine, from time to time, every prominent point within signal-distance, to see if signal communication is attempted from any quarter. With this view, they will study the vicinity of all houses, spires, peaks, hill-tops, broad open fields in the midst of woodlands (an open field commanding a view of a known fixed station is a spot always to be selected in a forest, on which to establish a moving station), the banks of rivers, prominent trees, stacks in fields, etc. The vicinity of smokes of any kind, seen at any time, must be carefully scrutinized. At night, all fire lights, or brilliant lights of any kind, are to be examined. Flashes must be particularly observed.

The Moving Station must be provided with some distinct and very visible signals, to attract attention. To mark positions anywhere in an overlooked country by day, smokes may be made. Puffs of smoke, made by firing powder loosely poured on the ground from cannon cartridges, can be seen at very great distances. The cartridges can be easily carried on horseback. They are fired with a train or

slow-match. These puffs may, to be distinctive, be varied in number. There should always be a prearranged code or understanding as to the number and kind of puffs or other signals to be shown.

A dense white smoke, visible at a long distance, can be made with dampened straw or hay. A fire should first be set well burning, and then large armfuls of the dampened straw, or armfuls of leafy branches, be thrown suddenly and well spread upon it.

A station which has difficulty in making itself visible will be apt to be discovered if moved near where artillery is firing, the attention of the observer being drawn by the report and the smoke of the guns.

The plan of Chronosemic Signals, and the use of the Signal Mortar with the Signal Bombs, affords one of the most powerful and certain modes of attracting attention.

Before a smoke-puff or signal of any kind is exhibited at the moving station, the largest white and red flags ought to be displayed together upon the signal flag-staff; and these should be kept in motion, swinging from side to side, near the point from which the smoke rises, while it is rising, and for some time after, in order that the glass, at the observing station, turned upon the smoke, may find the flag thus moving in its field of view. When the attempt to attract the attention of the observing station is to be long continued, a large flag will be fastened to a second staff, and kept hoisted in some prominent position; the pole being fastened, as in the corner of a fence, or to a stake driven into the ground.

At night, a signal-fire, made like any other fire, and meant to attract attention, is sometimes flashed, to distinguish it from other fires. This is done by causing two men to hold a blanket spread before it—that is, between it and the observing station—and to raise and lower this blanket every two seconds. This is ordered in this wise: “one-two-up;” “one-two-down,” and continue. The intermittent light, thus made,



is easily distinguished. The powder from cannon cartridges, poured loosely on the ground, and fired at night, makes an intense white flash, almost certain to attract attention. Two or three cartridges may be employed together, and fired at one flash, to increase the volume of light. Rockets and Roman candles are very useful. Composition lights, such as the Coston signal-lights, or the common red, white, or green composition lights are also useful. They will attract attention at distances of six or eight miles. Red lights are preferable to any other, for the reason that they show distinct among camp-fires, or other lights, and cannot be confounded with them. The volume of light may be increased for great distances by emptying the composition from several lights together, and thus firing it. Any kind of colored composition light may be agreed upon to be shown as a preconcerted signal, by which all friendly signal-officers, as, for instance, those serving with a single army or a single corps, may indicate their position at night.

Thus a "red-white-green" composition cartridge might be the general night-signal for all forces belonging to the United States Army; while the different composition lights known by their numbers "one," "two," "three," etc., as given at p. 216, might be the distinctive signal for the Army Corps by their numbers.

Any Detachment of any Corps may thus show its signal-number from any position.

Thus a "red-white-green" cartridge fired, and followed by a "red-white," would signal and indicate the position of "Headquarters—5th Army Corps."

A "red-white" cartridge fired alone would indicate "Detachment of 5th Army Corps." Distinctive Chronosemic Signals may be arranged for the same purpose, and there may be certain secret signals to be fired by order of corps commanders only, and understood by the general-in-chief alone.

A certain signal, as of guns or rockets or colored lights, should be given to each general or admiral only, as a means by which, as by a countersign, to recognize friendly forces.

Attempts to attract the attention of a station, in order to be successful, must be persistent. They should never be abandoned, until every device has been exhausted: and they should be renewed and continued at different hours of the day and night. It must be always remembered, that attempts which have failed may have failed because the observer's attention has been drawn in another direction, and that the effort may, at any other moment, be a success, if the observing-glass chances to bear on the calling signals.

During the whole time that attention signals are making, by day or by night, the calling or moving station must watch closely with the telescope the station called; nor should the watch be relaxed, at any time, until communication is fairly opened. It can never be known at what moment the observing station may first have sight of, or be ready to reply to, the signal seen. Should the efforts of the calling or moving station be successful, and attract attention of the observing station, the observing or fixed station ought to reply at once with signals of recognition and a brief message—as, “I see you,” etc.; or, if it is practicable, it should make a signal similar to that seen: as answering smoke by smoke; a rocket by a rocket; composition lights by composition lights; or making some marked signal which shall announce to the moving station the fact that its position is noted. The observing station should take care to keep a signal-flag flying all the time, to afford a marked point to the moving station, and to indicate that an officer is on duty and at the glass.

It not unfrequently happens that two moving stations are in quest of each other. In this case each should seek dominant points, or points in view of dominant points as far as possible in the direction of the other, and thence endeavor

to open communication. And it should be a general rule for all such cases, that at certain agreed hours, as at six A. M., nine A. M., noon, three P. M., six P. M., nine P. M., midnight, etc., each shall be at some dominant station seeking for the other, or shall make signals agreed upon, wherever they may be, for, say fifteen minutes.

This rule of signalling at predetermined hours applies to all attempts to open communication. Timepieces must be adjusted together.

A signalist, observing from an elevated station, and finding his own view of the communicating station uninterrupted, may be led to imagine that the station on which he stands is more prominently visible, from the communicating station, than is the case in fact. Thus a person viewing from the top of a house, may think the whole house is in view from the observing station, when in fact nothing but the roof can be thence seen. Or located behind a ridge, the signalist may think his whole station in good view, when, perhaps, his head only is visible from that communicating. To determine whether any station is clearly in view from any other, the observing station must be viewed from the ground, and from different positions close to the station. If the station can be well seen from these different points, that from which these observations are made must of course be plainly visible.

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In locating stations, and in opening communication between them, an officer will sometimes find himself in a position whence some other station ought to be visible, but finds his view shut off by trees or bushes near him. In this case, the tallest tree should be climbed. If the other station is in view from the tree-top, its attention can be attracted, and a temporary communication be opened, by signals made

by the flag, or other signal, displayed in the tree-top. The flagman may then secure himself in the tree with a belt or rope. The officer fixes his own position at some other place in the same tree, and rests his telescope among its branches; or what is better, ascends another tree for this purpose,—as the first is apt to be so shaken by the motions of the flagman, as to disturb the vision through the telescope. The stations having recognized each the position of the other, telegraphic communication will be had without difficulty.

It should be borne in mind by an officer on signal duty, that it is very possible his own signals may be seen and read by the officer with whom he wishes to communicate, though it may be impossible for him to find the exact position of that officer; or having found it, it may be impossible for him to read the signals made to him, owing to defect of light, or smoke, or glare, or haze. It is a rule, therefore, to send any important message, or any information it is wished to convey, whenever the sending station is in a position whence the signals ought to be seen by the other station. There is a chance, to be considered, that some third station may receive the message, and the information be thus available. This is, of course, not to be considered as a final sending of the message—a message never being considered as sent, by signals, until it is clearly acknowledged by signals. This plan may, however, be sometimes useful. There are also, sometimes, intervals of two or three hours when the position of the sun, or a peculiar haze or light, makes one of two communicating stations almost invisible, while the other is thence seen more clearly than is usual. Now the visible station ought not to waste this time, but to send forward its messages with great care and distinctness, numbering the words, etc. This should not be attempted, however, unless the sending station is, while sending, always able to see at least the signals of recognition or “to repeat,” made at the close of each mes-

sage by the receiving station. As soon as mutual communication is had again, full inquiry can be made as to the receipt of the message thus sent. So one officer may find himself so close to the enemy that he dare not respond to any signals, yet may perfectly read those made from another station. It may be important to send information by signals to an officer thus situated without caring to wait his reply. There are other possible cases in which messages may be sent when it is known that they cannot be either acknowledged or answered by signals. A station may sometimes receive many messages, when the messages sent by it cannot be read. It frequently happens that the signal of recognition, "message understood," and of "repeat, message not understood"—which two signals are sufficient to insure the correct reception of messages—can be seen, made by a station, when no consecutive signals made by that station are visible. Or a conventional signal, as a puff of smoke, may be agreed upon to indicate "messages understood," before the signal parties separate. Two puffs might mean "repeat;" or any other signal may be adopted. On the same principle, an officer calling a station with his flag, and being without reply, or with such replies only as he is unable to read, continuing to call, may interpose messages; for his flag is as visible and as likely to attract attention while sending a message, as while simply waving for attention. Thus such a message as this may be transmitted: "I cannot see you. Am going to the top of the mountain;" or, "Can't see you. Look for me on the steeple;" or, "Can't see you. Go to open field on crest of ridge," etc.; or, "Can't see you. Enemy are coming by this road," etc. This rule applies to night-signals when, sometimes, one station distinctly sees the signals of another, but cannot reply with signals of the same kind, because the apparatus is broken, or the supply of fluid for the lights is exhausted. If in such a case a station is called, it replies by burning a

signal-light, or by throwing up a rocket, or by making a camp-fire flash, or by flashing gunpowder: the message may then be sent. If it is correctly received, the disabled station shows two flashes, or throws up two rockets, or displays two lights. If the message is not correctly received, only a single flash, or rocket, or light is shown. This indicates that the message must be repeated. A station can hardly be so disabled but that an experienced officer will be able to make this much of recognition. It is impossible he should be without some kind of light that can be seen, or the power to make some one of the numberless styles of signals.

It will be found sometimes possible to signal between elevated peaks, when all the landscape of the lower country is deeply buried in fog; and, conversely, a peak will sometimes be wrapped in clouds, when lower down the view is unobstructed. In the former case, messages may be sent by ascending to mountain summits; and in the latter case, by descending, so as to be below the cloud stratum.

It is sometimes necessary for stations to change positions while working. In this case the observing station should carefully watch the flag of the moving station, which must be carried flying, in order that it may be readily traced to the new situation. A movement of a station sometimes becomes necessary, at the request of a communicating station, to improve the background, or the view of the moved station. These movements are often for a few yards only. In such case, the moving station, carrying its own flag flying, must carefully watch the flag of the observing station, which is kept in view in order that it may be so watched, and the movement must be instantly stopped at the signal from the observing station, which indicates when the moving flag has reached the precise position desired.

The signal "22, 22, 22, 3," from the observing station, is the signal to stop the movement.

When there is any trouble about the visibility of signals, the largest and brightest flags, or other signals, should at once be used. It will often happen, that after working thus for a short time, the signalist, becoming accustomed to the range, will work successfully with smaller signals.

When, at the receiving station, it is noticed that a change in the color of the signals shown at the sending station would render them more visible, the fact should be immediately stated. When there is any question as to the color of signals to be shown at the different stations, each station should indicate to the other that color most distinctly visible from its own point of view.

#### ESTABLISHING SIGNAL-STATIONS.

When high winds interfere with the proper display of flags, or other signals, at any position, the signal-station there ought to be established in the lee of a grove, or sheltered by a house or hill. It will sometimes happen that signals made from a given position cannot be seen; while, near that position, is a point at which a sky-exposure, or other advantage, can be had, which will make the signals there visible. In such case, the receiving station should direct the sending station where to place the flagman. This may be done by the usual signals of the codes prepared for the purpose, or by an especial message.

Communicating stations ought not, when it can be avoided, to be located exactly on an east and west line, or the line of the apparent course of the sun. That station which is in the direction from which the sun shines in any part of its course, is very liable to seem to be enveloped in a haze, and the telescope, if turned upon it, is filled with a dazzling light.

The landscape is often seen as perfectly clear, and signals are plainly visible in every direction, excepting toward the

rising or setting sun. There is a bright haze. It is better, therefore, that the line of the stations should obliquely cross the apparent course of the sun, and care should be taken to so arrange them. If that cannot be done, the stations lying in the apparent course of the sun should be so located that they may have a sky-exposure when viewed from the communicating station. This obviates, to a very great extent, the difficulty of sun haze; and wherever that difficulty exists, effort should, at once, be made to secure such an exposure for the obscured station.

In the same way, when there are temporary interruptions, as often happens from clouds passing the sun, a sky-exposure secured for the obscured station will render all signals there displayed, legible.

A station should never be located in a camp, or among tents, or where the white canvas of tents can form the background of signals viewed from the other station. The passage of squads of men in an encampment, the smoke from the numerous cook-fires, the dust thrown up by marching troops or trains, the curiosity of persons not attached to the station, render the camp the most unsuitable locality for a signal-station. The difficulties are increased, at night, by the glare of the numerous fires apt to be kindled between the communicating stations; the smoke that, then more heavily than in the day, rests over the quarters; and the almost impossibility of distinguishing, at great distances, the signal-torches or lights from the changing lights of the encampment. Every precaution should be taken to avoid these annoyances. The point chosen ought to be one sufficiently near the headquarters of the general commanding, but outside of camp, and on one side of it, on some clearly visible spot, and with as few encampments between it and the communicating station as possible. It is always advisable to avoid working over an encampment, if it is near and on nearly the same level as the station. The smoke



and dust which constantly arise from a camp are serious obstacles to successful working.

Red lights or rockets must be kept at encampment stations, to mark the exact position of that station, if the communicating station is very far distant, and the officers at it thus liable to be confused by the number of lights and fires at the encampment. This will be found to be often the case, when the stations are located among the camps of a grand army.

Signal stations should always be chosen elevated from the ground as much as is possible, when there is difficulty about smoke, or haze, or dust. The undulation of the atmosphere, noticeable on a hot summer's day, is always less at a distance from the earth's surface. Thus it is sometimes practicable to read from a tree or a house-top when it is almost impossible to so read from the ground. This undulation is less also over spots well shaded than in the glare of the sun. This should be borne in mind in all telescopic examinations. Permanent stations should never be placed in hollows, or on low land, when high ground is attainable. The greatest elevation should invariably be sought. In the cool night air, the smoke and dust of the day lie close to the ground, filling the hollows and obscuring low lands, while the higher points emerge in view like islands. So, too, the elevated points are free, to a great extent, from heavy moving mists and the malaria of unhealthy locations. There are these advantages, aside from their better location, for working. By careful selections of high ground, stations can often be worked when signals on the lower fields would be invisible. For these reasons, it is well to have, sometimes, a station for night work on a house-top or in a tree, while during the day the station is worked from the ground.

## REPEATING STATIONS.

It may happen that very important messages received by signals must be verified by repeating back from the receiving station, signal by signal, each signal used by the sending station, in conveying the message. There can be no error in signals thus verified, and the correct transmission of the message is made certain. This process has been referred to while describing the different codes.

For such a verification, each signal must be repeated by the receiving station, as soon as it is made at the sending station.

The signalists and their signalmen, at each station, face toward each other, the signalmen standing each with his flag and staff in the first position for signals. The chief of each of the corresponding stations has his glass fixed upon the opposite station, and takes his post at the glass. The sending of the message is commenced. As the chief at the receiving station notices each signal completed by the sending station, he orders that signal at his own station. The chief at the sending station pauses after each signal of the message made at his own station, until he has noted that signal repeated correctly at the receiving station.

The symbol-numbers made at each station must be identical. The signals used may be different, provided they signify the same numbers. Thus, if "one-two" is made at one station, "one-two" must be repeated at the other, though the symbol-numbers, "one" and "two," may be indicated at one station by different signs from those which indicate the same numbers at the other station. The messages are thus transmitted, signal by signal, the sender pausing after each signal, until he sees a similar signal shown, complete and correct, at the receiving station. It is then certain that his own signal has been seen and noted. A record of the signals shown at each station is kept at the other.

This record and the record of messages sent must agree. The practice of repeating signals was habitual when semaphores were much employed for telegraphing. It is used with advantage, in many instances, with field-signals, particularly with those which are made by positions.

A message may be repeated, letter by letter, or word by word, or sentence by sentence; or the whole message is recorded as received, and is repeated back from the receiving station.

The occasions for such exactness as requires the trouble of repetition must be determined by the commanding officers, or by the chiefs of stations dispatching the messages.

It should be made habitual, rather than incur any risks from the incorrect transmission of a single message. Where cipher is constantly employed the verification insures its accuracy, and will sometimes prevent the trouble in interpretation which may arise from an error.

The repetition of signals, for the transmission of messages over long lines, is differently managed.

Where repetition is to be habitual over long lines, some of the simple semaphores, once of common use, afford perhaps the most rapid and available means for communication. They have been improved by long experience to a degree which renders them almost perfect. For ordinary ranges, and for common military uses, any of the different manual codes, heretofore described, are always available. Permanent semaphores need not be used except for convenience, or when a long line is to be worked continuously with a feeble force.

Temporary semaphores may be of the most simple structure, as before described. The human figure, light clad, so as to show prominently on a dark ground, or dark clad when exposed against the sky, makes, with its movable arms, one of the best semaphores. Thus a man, with his coat off, is an upright with two movable and jointed arms. There is hardly any kind of position-signals but can be made

by placing the arms of this man in different positions. This human semaphore is visible, and the signals made by it are legible, with a good telescope, for a number of miles. To make the signals more distinct, at a great distance, disks, attached to rods, or flags, or brilliantly colored and broad staves, or any showy object, may be held in the hands and moved as semaphoric arms. To give elevation, the signal-man may be upon a staging, or perched upon a standing tree-trunk, the tree-top being removed.

When a message is to be repeated over a line of stations, by either transient or permanent signals, a warning signal is first given, in order that there may be proper attention at the intermediate stations before commencing the message. This warning may be a message, as thus—"repeat to" (naming the town); or it is a concerted signal, as both arms of the semaphore pointing up. This warning is sent from station to station, until it reaches the station named; this station replies by a concerted signal of "ready," and each immediate station, repeating this signal back to the first station, stands ready to repeat the message which the first station commences to forward, signal by signal, at once on receiving the ready signal; the intermediate stations repeating each signal letter and number as fast as they are received; as, for instance, was a message to be sent from Washington to Frederick, the officer at Washington would first send over the signal line the warning to "repeat to Frederick." This warning is repeated from station to station. On receiving it, the officer at Frederick makes the ready signal, which signal is repeated back, from station to station, to Washington. Each station then stands ready to repeat the signal message which is to follow. On receiving the ready signal, the officer at Washington sends forward the communication, each station repeating each letter-signal in its turn as it receives them.

When a message is being thus repeated through a num-

ber of signal-stations, the officer at each station will call the proper numbers for each letter, as he receives them, to his flagman, who, placed facing from the sending station and toward the station next in line, makes each signal in its proper order. Each officer, after signalling from his station each letter, waits until he sees it repeated at the next station before he signals another. There are two men, with telescopes, at each repeating station: one notes the correct reception, the other the transmission of the signals.

The advantage of permanent signals here becomes apparent, for a permanent signal may be kept in view until it is repeated with certain correctness. All signals made at the repeating station will appear to the observers at the sending station reversed: When permanent signals are used, each sending station keeps its signal in view until that signal has been repeated at the next station, when it resumes the position ready, and waits the next signal from the sending station.

Long lines of signal-stations, with a small military force at each, being thus each in communication with the other, may constitute picket-lines of great length and importance for holding and keeping under observation lines of communication, rivers, or extensive tracts of country liable to incursion or to be ravaged by predatory bands of the enemy;—each station, having the power of communicating with those on either side of it, has virtually the advantage of their support, and no one can be attacked without the enemy being exposed to the concentration of forces called for by signals from different stations.

So, when an army has for its duty only to watch a certain line, by a judicious arrangement of signal-posts upon that line, a heavy force lying back of it, it can be made almost impossible for the enemy to pass the line without encountering concentrated forces.

A river passing through an enemy's country, with com-

merce upon it liable to interruption by guerrilla attacks, or by forces of the enemy, can, by the establishment of small fortified signal-stations, say at a distance of nine or ten miles apart, garrisoned and communicating, be virtually picketed and be made safe for commerce. This was proposed during the war in the case of the Mississippi.

On river lines, where the protection of commerce is of importance, such stations afford at once shelter to the moving vessels, are able to warn them, while at a distance, of danger, as of the location of the enemy upon the banks; or, in case of attack, to call to their assistance the vessels of war assigned to the duty of patrolling the stream. On the great river courses of this country, picket lines of this description, guarding our rivers passing hostile territory, have an especial usefulness.

The communications may be by telegraphic wires, until the near approach of an enemy disables that mode of communication.

The military reader will comprehend how the beautiful plans for chronosemic signals would be employed in such cases, as above described, by repetitions, and how exactly they would indicate the point endangered.

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### COMPLICATING SIGNALS.

Signals are complicated for the purpose of disguise. For example: several things, positions, motions, each one of which may of itself represent an elementary signal, are assumed. Now, in a code of two elements, any one of these indications given may signify the "one" element as often as it is shown, while the "two" element is signified whenever any one of all the rest is shown. Thus, if five motions are given, and we propose to complicate an alphabet of two elements, in which the letters of the alphabet shall read "A" is "two-

two" "22," "B" is "two-one-one-two" "2112," "C" is "one-two-one" "121," and so on: Suppose the five motions given are known as the first, second, third, fourth, and fifth motions, and are designated by the figures 1, 2, 3, 4, and 5; the motion "1," as often as shown, may signify the element "one," while either of motions "2," or "3," or "4," or "5" may signify, whenever shown, the element "two." Then, in the example given, "A," which is known as "two-two" "22," may be written or signalled and read with equal ease when shown as "two-two" "22," or "two-three" "23," or "two-four" "24," or "three-three" "33," or "four-five" "45," or "five-two" "52," etc. "B," which is known as "two-one-one-two" "2112," may be written, or signalled, or read as "two-one-one-two," "2112;" or as "three-one-one-four," "3114;" or "five-one-one-five," "5115;" or "two-one-one-three," "2113;" or "four-one-one-three," "4113;" or "five-one-one-two," "5112," etc. "C," which is known as "one-two-one" "121," may be written, or signalled, or read as "one-two-one," "121;" or "one-five-one," "151;" or "one three-one," "131;" or "one-four-one," "141," etc., and so on for the alphabet.

Or the element "one" might be signified by several signs, while the element "two" is signified by a single sign. Or the element "one" might be signified by each of two or three or more signs, while the element "two" is also signified by each of two or three or more signs. Thus four motions being used, a motion up or a motion to the right may each signify the element "one;" while a motion down or a motion to the left may each signify the element "two." Or all the motions that can be made on the right of a man may stand for "ones," while all the motions that can be made on his left may stand for "twos."

In a similar manner, if the alphabetic code is of three elements, each of the elements may be represented by several things or signs. And so in codes of four or five, or what-

ever number of elements, we may have each signal element signified by two or three or more signs.

It is not material, of course, what may be the elementary signs selected. Thus two or three different positions of the arm of a signalist may each stand for the same element or symbol in any letter.

Or if flashes are used, different-colored flashes may signify the same element. Or different sounds may have similar meanings. Or if flags are used, several different flags may signify each the same element or symbol. Thus with a code of three elements; if there are at hand nine flags, three different flags may be set aside for each element, and each of these flags signifies its element whenever shown.

Or with an alphabetic code of six elements, twelve flags may be used, each element signified by either of two flags.

The letters for message code-signals for brief codes may be shown in this way with complications which defy interpretation.

A message can be written to be sent in complicated signals. Thus, assuming that the ten motions will be for the ten numerals, always those described for the Code of Ten Elements, we may write out the symbols of a message written in a code of two elements in six figures, allowing three different figures for each symbol.

If the message is now signalled as it is written, it will appear in complicated signals, seemingly of six elementary signs, while to the reader they represent but two.

Messages prepared for codes of three or four or other numbers of elements may be complicated in the same way.

The correspondent must be informed by preconceived rules how many elements it is intended to convey, and how many and what symbols are to be used in the complication to represent each element.

The subject of complicating signals has been before



briefly mentioned while treating of the different alphabetic codes. It affords a clue to many curious plans for signs and for ciphers.

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### MESSAGES BY MESSENGERS.

There is record of many ingenious contrivances to send messages in secret, when it has been impossible for any reason to prepare a cipher.

An ancient plan was to inwrap a slightly tapering rod with a long and narrow strip of paper, in such way that the edges of the strip were in contact throughout its length. On this paper, in this position, the message was written from end to end of the rod, and in lines one beneath the other for its circumference. The receiver was furnished with a similar rod.

The message being written, the paper was unwrapped from the rod, and so appeared a strip of paper covered with fragments of words without apparent connection. It was so forwarded by messenger. Upon its receipt, the receiver, carefully wrapping it again upon the rod in his possession, found the fragmentary words conjoined and bearing a plainly written message.

Messages written with or without cipher may be concealed for transmission in the common wooden lead-pencil, it being first opened and hollowed for the purpose, and then joined as it was originally; or they may be packed in hollow canes, from which the handle or ferule easily removes.

They have been packed in bullets, or in brass buttons, etc.

A safe way is to carry the message or paper on top of the charge in a loaded pistol or musket; it is so easily disposed of in case of surprise or capture.

Papers are sometimes worked in between the leathers of the soles of boots or shoes, in the linings of clothing, etc.

The devices for this kind of transportation are so numerous that these are given only as specimens of the plans. There is hardly any article which it is safe to allow a suspected person passing the lines to carry, until it has been rigorously examined.

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## CRYPTOGRAMS.

Alphabets may be composed of hieroglyphic characters. Thus, take any number of marks or figures, however curious or complicated; devise an alphabet of one, two, three, or four elements, as the case may be; designate a number of marks or signs to correspond to the number of the elements, by numbers, as one, two, three, four, or five; then compose each letter by drawing and joining together, from left to right, those marks which stand for the numbers of the letter combination in the devised alphabet.

The following is an interesting illustration:

It is very likely that the arrow-head, which seems to be a sign used everywhere by savages in their first attempts at writing, appeared often and was prominent among the signs of early hieroglyphs. With the earliest specimens of recorded language which have come down to us, and which have drawn the attention of philologists, are the specimens known as the cuneiform or arrow-head character. All the characters of this writing are made up of arrow-heads. It is stated that arrow-head characters are found stamped on each of the bricks of the tower of Babel. Specimens of this character are rare, and to but very few are they intelligible. None but those savans who have devoted themselves to the study can either write or read them, and few but profound

scholars would attempt it. It is a curious experiment, and one illustrative of the manner in which alphabets are formed, to show how easily this character can be turned to the most common uses. To form an alphabet of enneiform characters, and to write the English language in that character, is one of the simplest acts.

The arrow-headed or wedge-shaped line is, perhaps, the plainest mark which one, setting out to devise an alphabet of characters, can use. It is only a mark broader at one end than at the other, so that it can be seen in which way it is pointed. Such a line can be drawn on paper in four ways, pointing up, pointing down, pointing to the right, pointing to the left. It can represent four elements. Now, there can be two sizes of such a line—a large and a small size. The small wedge or arrow line can also, on paper, point up, point down, point right, and point left. It can thus represent four more elements or four symbols. Using, then, two arrow-heads or wedges, large and small, there can be represented, drawn on paper, eight distinct elements or eight symbols. These may be designated the four positions of the large arrow-head, as one, two, three, four; the four positions of the small arrow-head, as five, six, seven, eight.

Now these large and small arrow-heads, drawn on paper, are to be used placed together in different combinations to represent the characters of the English alphabet. To do this it is only necessary to devise, by the rules for forming alphabets before given, an alphabet of twenty-six letter-combinations having eight elements given, and to draw on paper, placed close together, and properly placed, the arrow-heads of the proper sizes, which are to stand for each letter. The total of the combinations which can be made with two arrow-heads, using the four positions for each, will be more than are necessary for any alphabet. Or the alphabet-code

to be devised may be of a less number of elements, as of one, or two, or three, or four elements. It is not necessary, then, to use so many positions or so many sizes of the arrow-heads. It would be needed to join together arrow-heads in two or three positions only.

In such examples, carefully studied and thoroughly understood, may be found a key for the preparation of many hieroglyphic ciphers; and we realize by them, as it is important we should, how readily any other characters may have the same force and meaning as those to which we are used, and which we have come to regard as if they were the only forms of letters.

Suppose, as another illustration, that, for a code of two elements, all straight lines or combinations of straight lines are to stand for "ones," and all curved lines or combinations of curved lines for "twos;" we see how easily any marks or signs, the most complicated or grotesque, chosen by us, may indicate the different elements in every letter, and how illimitable is the power of forming hieroglyphic ciphers. To thus write the English language in arrow-head cipher or to systematically devise hieroglyphs, is at once a source of amusement, and is a valuable practice to the signalist, who may be called upon, at any time, to form a cipher for military use.

These modes of devising alphabets on a systematized plan by numerical elements afford, perhaps, not impossible illustrations of the modes of making the first alphabetic characters. It is probable, however, that the characters representative of sounds were formed with certain elements, it is true, of necessity, but with those elements conjoined arbitrarily and without a plan.

It is proposed here to explain two or three only of the plans for forming cryptographic alphabets, and to leave to ingenuity to devise the innumerable other forms which may be given.

Suppose Arrow-heads representing the figure-symbols are—

Λ stands for 1, Υ stands for 2, > stands for 3, < stands for 4, λ stands for 5, γ stands for 6, > stands for 7, < stands for 8.

Then, A is 12, is ΛΥ; B is 13, is Λ>; C is 14, is Λ<; D is 22, is ΥΥ; M is 52, is λΥ; N is 53, is λ>; Y is 85, is <λ; and so for the letters of the alphabet. (See Code of Eight Elements.)

The message, "We move at midnight," is, in

#### SIGNAL NUMBERS:

83 23—52 54 82 23—12 73—52 34 22 53 34 32 33 73;

#### CRYPTOGRAM:

→ Υ> λΥ λ< <Υ Υ> ΛΥ >>  
 λΥ >< ΥΥ λ> >< >Υ ≍ >>

Or referring to the General Service Code of two elements (page 53,) assume that all large arrow-heads, however pointing, are "ones;" all small arrow-heads, however pointing, "twos." Then,

"We move at midnight."

#### SIGNAL NUMBERS.

1121 12—1221 21 1222 12—22 2—1221 1 222 11 1 2211 122 2

#### CRYPTOGRAM.

ΥΥ>Υ Λλ Υ≍Λ ΥΥ Υ≍ ΥΥ < λ  
 ΛλλΛ > γλ Υλ Υ ≍ΥΥ λ≍ γ

Or all straight lines or combinations of straight lines are "ones;" all curved lines or combinations of curved lines are "twos." Then,

"We move at midnight."

#### CRYPTOGRAM.

33 3 5 Z<sup>s</sup> D 5 °  
 5 1 5 1 R 5 1 5 5

It is needed only to keep the letters and words clearly separated, and to show markedly the distinction between the straight and curved lines.

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With the rules that have already been given for the formation of alphabets, it is plain that messages may be sent as in bouquets of flowers. If the alphabet to be used was one of five elements, five kinds of flowers or leaves would be necessary; only two of them need be used together to indicate any letter. The buds, leaves, etc., placed together in sequence in a bouquet, would indicate letters, and thus words might be formed. Quite a lengthy message might be sent in one of the large basket-bouquets that are sometimes seen. So messages may be sent by nails on the shoes of a messenger, there being two or three different kinds of nails. Thus small-headed nails to stand for "ones," larger nails for "twos," still larger for "threes:" the nails driven in rows across the sole, as if to strengthen it. Or messages may be sent by pictures and drawings, which he will carry. In drawing the representations of shingles upon a roof, or in any drawing of a fence or of a flock of birds, letters indicated by long and short marks, or by different kinds of marks, may be ingeniously represented. So long messages

may be sent, the letters being represented by different figures, in papers which appear to be grocers' or commissary bills, and which, in the search of a prisoner, would hardly attract attention. For example:

“OFFICE of A. A. C. S.

“Memorandum of stores issued.

Pork (bbls.)	.....	2551
Beef (rations)	.....	33,531651
Salt (sacks)	.....	1154
Coffee	} (rations).	33,424143
Hard-bread		42,223254.”

The General Service Homographic Code is assumed as used. (Page 144.)

A word is enciphered on each line.

Where two or more lines are connected by brackets, the figures opposite form one word.

To interpret: Point off the figures by twos; write over each two the letters indicated.

The message is, “We move at midnight.”

Or letters may be sent in ludicrous sketches. Thus letters may be indicated by little figures of men.

For instance, those standing upright with neither feet nor hands raised to be “ones,” those holding up a right arm to be “twos,” those holding up a left arm to be “threes,” those with right foot raised to be “fours,” those with left foot raised to be “fives,” those with both feet raised to be “sixes.”



To interpret: Point off the forms by twos, place under each the figure for which it stands, ascertain the letters indicated.

The message is, "We move at midnight."

These illustrations are made as suggestive of those which may be formed. Spaces have been left between the words to lessen the labor of the reader; these may be omitted in actual use.

The facts may seem rather curious than useful. They are given to impress upon the mind of the reader the infinite varieties of cryptograms he can, with a little practice, have at his command. (See "Complicating Signals," page 272.)

Among the best disguises of letters is to represent some one or more of the elements by more than one symbol. For instance: use six symbols for an alphabetical code of two elements. Let any three of the symbols represent the first element, and the remaining three the second element.

Then, 1, 2, 3 are "ones," and 4, 5, 6 are "twos."

Then, "We move at midnight"—

Or, "1121 12—1221 21 1222 12—22 2—1221 1 222 11 1 2211 122 2"—

May be, "1243 26—3452 63 2456 34—45 6—1642 3 444 32 2 5423 365 4."

Or it may be, "3263 35—2463 52 2655 35—64 5—3652 2 556 13 3 4532 254 6."

There are many such changes.

Or, still using a code of two elements, let any figures up to three, or any other figures agreed upon, read as "ones," and all other figures read as "twos."

Then the same message may be:

"3293 28—2693 82 3768 25—97 9—2571 2 547 22 3 6523 168 7."

And on such plans the changes can be infinitely extended.

Of course, any other marks or written signs, of any kind,



might be used as symbols instead of figures, and then be combined in this way to stand for the letters of any language. Alphabets can be formed in this manner, and pages can be written, in which no letter will appear twice in the same guise; and indeed it will be impossible for the writer, without some effort, to ever make a letter twice alike.

An illustration of this fact is had in the cryptogram of straight and curved lines. (Page 280.)

So with colors: as having six or any number of colors. Let three of the colors represent the "one," and the other three the "two," as often as any one of them is exhibited.

For illustration: Suppose the colors to be red, green, yellow, blue, orange, purple. Designate them by initials, as r, g, y, b, o, p; then r, g, y are "ones," b, o, p are "twos."

A message might be exhibited in marks of colors, as follows: The color being substituted in each place for its initial.

"We move at midnight."

1121 12—1221 21 1222 12—22 2—1221 1 222 11 1  
 rgby gb yopg br gbop rp op b gopr r pob gr y  
 2211 122 2.  
 pbrg ybo p.

Or it might be written in many different arrangements of these color marks,—all representing, however, the same symbols, "one" and "two," and in the same arrangement.

Ciphers of these kinds are safe, and sometimes valuable for military uses. As an example of another mode of writing, let it be supposed that it was agreed that an alphabet should be constructed to be of five elements; that the first might be represented by any one of five letters of the alphabet; the second by any one of other five letters of the alphabet; the third by any one of other five let-

ters; the fourth by any one of other five letters; the fifth by any one of other five letters. The end of a word to be indicated by a blotted letter, or by a flourish, or by an imperfect letter, or by any one of a hundred signs ingenuity would devise. It would be very difficult to translate a message formed in this manner.

For illustration, the message, "Fleet sails to-morrow." Give to the alphabet the enumeration of a code of five elements. (See alphabet of five elements.) Form a table thus:

1 is a f k p u v—read thus, "1" is a, or f, or k, or p, or u, or v.

2 is b g l q w—read thus, "2" is b, or g, or l, or q, or w.

3 is c h m r x—read thus, "3" is c, or h, or m, or r, or x.

4 is d i n s y—read thus, "4" is d, or i, or n, or s, or y.

5 is e j o t z—read thus, "5" is e, or j, or o, or t, or z.

Now, F is "12," is say "fb." It might be aq, or kl, or any conjunction of any of the five letters standing for "1" with any of the five letters standing for "2."

L is "23," is say "qm." It might be any conjunction of the letters standing for "2" and "3."

E is "51," is say "ta," or any conjunction of the letters for "5" and "1."

E is "51," is say "zp"—differing from the preceding "E."

T is "54," is say "ey," or other conjunction of letters "5" and "4."

Thus for the word "Fleet" we write "Fbqmtazpey." Continuing thus we find the whole message may be written "Fbqmtazpey nyapmuggrdi jiernerzxcimnjebo"—Fleet sails to-morrow. To decipher: As each letter is known to be here represented by two letters, we point off this cipher by twos, and referring to the table we find:

"fb" is "12" is F, "qm" is "23" is "l," and so on.

It will be observed that following this plan the same words, though often written in the cipher, might never twice appear in the same guise.

The following is an interesting cryptogram, but has the disadvantage that, as the characters do not change in the same message, it is decipherable. It is given for the reason that it may be sometimes encountered.

The letters of the alphabet are represented by the figures as given in the plan:

a b c	d e f	g h i
1 2 3	1 2 3	1 2 3
j k l	m n o	p q r
1 2 3	1 2 3	1 2 3
s t u	v w x	y z
1 2 3	1 2 3	1 2

It will be seen that there are three figures in each space, except the last, in which are two. There is thus a figure for each letter to be represented.

Then the first three letters of the alphabet—first, second, and third, A, B, C—are represented respectively by the three figures in the first space of the form; or, as they would be written, A is 1, B is 2, C is 3. The *second* three letters of the alphabet, D, E, F, are represented by the three figures in the second space of the form; or, as they would be written, D is 1, E is 2, F is 3. The *third* three letters of the alphabet, G, H, I, are represented by the figures in the third space of the form, as G is 1, H is 2, I is 3; and so on for all the rest, the letters of the alphabet, in their usual sequence, being set off by threes, and each letter of each three being represented by one of the figures found in the corresponding numbered compartment of the form, and exhibited in an *outline* similar to the outline of that compartment of the form in which it is found. Thus:

“We move at midnight”—

2 2 1 3 1 2 1 2 1 3 1 2 3 1 2 2

The figures need not necessarily be 1, 2, 3, etc., in the usual sequence in each compartment. The numeral digits might be used, as 1, 2, 3, in the first compartment; 4, 5, 6, in the second; 7, 8, 9, in the third: commencing anew, 1, 2, 3, in the fourth; 4, 5, 6, in the fifth, and thus on. In such case D would be [4], E [5], etc. Or it might be concerted that the letters of the alphabet were not to follow each other in the usual sequence, but in some other order.

The cipher is capable of many changes.

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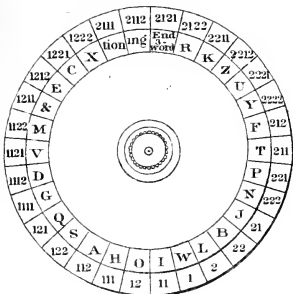
### SIGNALLING IN CIPHER.

If signals are to be displayed in the presence of an enemy, they must be guarded by ciphers. The ciphers must be capable of frequent changes. The rules by which these changes are made must be simple. Ciphers are undiscoverable in proportion as their changes are frequent, and as the messages in each change are brief. When alphabet ciphers are used, the aim should be never to allow any letter to appear twice alike. The number of letters under each key is to be as small as possible. The terminations of words are to be concealed. The letters in each word ought to be made in unusual sequence. For this purpose a message to be enciphered may be wholly reversed—that is, written with the last word appearing first. Each word may also be reversed. It does not do away with the utility of ciphers that they may be sometimes deciphered, for we must often use them, conscious that, with sufficient time and the appliances, they can be interpreted; but knowing, also, that the time interpretation will require will render the message useless to an enemy.



# PLATE XXVI.

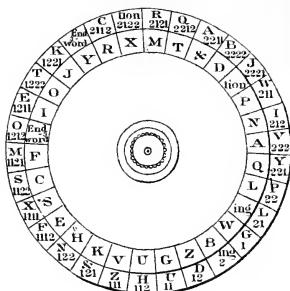
Figure 1.



Two Discs.

Vertical Section

Figure 2.

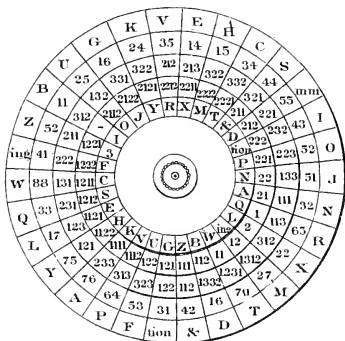


Two Discs.

Figure 3.



Figure 4.



Plan for Service Discs.

Figure 5.



Vertical Section exhibiting plan for four Discs.

Simple devices have rendered it practicable to so exhibit signals that their interpretation becomes almost impossible. The entire code may change with every day, with every message, or with every word of every message.

The Signal Disk is as follows:

*Description of Signal Disk.*—On a small disk of cardboard, or other material (Plate XXVI, Fig. 1), are written or printed the letters of the alphabet in irregular sequence and arranged around the circumference of the disk. These letters are so placed that when the disk is properly held, all the letters are upright. On this small disk are also printed those combinations of letters which frequently occur in words, as “tion,” “ing,” “ous,” etc., etc., and a sign to mark “the end of a word.” On a larger disk are written or printed, arranged around its circumference in the same manner, either the letters of the alphabet or the symbolic numbers of signals which are to be used.

The disks are fastened concentrically together in such manner that one may revolve upon the other, and that they may be clamped in any position. They are of such sizes that when so fastened, the letters, etc., upon the inner disk, will each appear close to and directly opposite one of the signal combinations upon the outer disk. (See Plate XXVI, Fig. 1.)

The figures “1” and “8” are sometimes used instead of the figures “1” and “2,” to symbolize the elements “one” and “two,” because the figure “8” is upright in most positions of the disk.

Having a disk arranged and clamped as at Fig. 1, Plate XXVI, it will be clearly understood by any signalist that, so provided, he has before him an alphabetic code with every letter opposite its signal symbols. And he will comprehend that, by referring to the disk, he can transmit a message without the study of any particular code, and can transmit

it in secret signals or cipher by moving the disks upon each other, and so making changes in the code.

Thus, to make "A," the combination "112," "one, one, two," is signalled; to make "C," the combination "1221," "one, two, two, one," is signalled; to make "T," the combination "211," "two, one, one," is signalled; to make "ing," the combination "2112," "two, one, one, two," is signalled. And there is so signalled the word "Acting." To denote the end of the word, the common "pause-signal," "3" "three," may be used, or whatever combination may be in the compartment opposite the character for "end of word." This is arranged by preconcert, and so for any words. Clauses, etc., are made by repetitions of the pause-signal. Now, it is evident that with any change of the relative positions of the disks made, as by rotating one upon the other, the whole code of alphabetic signals is changed. Thus, suppose the inner disk rotated until the letter "A" is opposite the combination "1112," "one, one, one, two." Then referring to the same Plate, to signal the word "Acting:" "A" is "1112," "C" is "2121," "T" is "22," "ing" is "2212." The signals do not in any way resemble those before exhibited for the same word. The signal for the "end of word" will also be different. These changes can be indefinitely varied. It is for making them that the disks are movable.

Where different parties, as the officers of a corps or of an army, are to be in communication, rules for the changing of the disks issued to all enable each to use them whenever the officers are in view of each other; each finding that his cipher will then correspond with that of the officer with whom he is signalling. And this may be, though the signalists have never met, and may be serving with detachments which have these communications with each other for the first time.

The following is an example of a General Rule for the use



of Signal Disks. The signal disk is supposed to be arranged for a code of two elements. The communicating parties have disks similar, and like Fig. 1, Plate XXVI.

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## RULES AND EXPLANATIONS FOR THE USE OF SIGNAL DISKS.

### I.—EXPLANATION OF THE SIGNAL DISK.

The numerals on the outer rim of the disk represent the combinations to be made with a flag or torch. Each combination represents, when made, that letter on the inner disk which coincides with it.

### II.—TO MAKE SIGNALS.

The signals, for whatever code signals may be represented by the symbols upon the outer disks, are made according to the rules heretofore given while treating of the different codes.

### III.—THE ADJUSTMENT LETTER.

The adjustment-letter is any letter selected on the inner disk, which, placed opposite a given combination or key-letter, on the outer disk, adjusts the disks for the cipher, and is the key to any communication sent in that particular cipher.

The letter R is understood to be the adjustment-letter, if no other letter is given.

The combination to be used with the adjustment-letter is called the key-number.

The adjustment-letter and the signal combination being given, the inner disk will be turned so that the letter will

coincide with the combination. Example: The combination is "1212," adjustment-letter R—the inner disk will be turned so that R will coincide with "1212." Any letter may be the adjustment-letter. Any signal combination may be chosen for the key-number.

Example: the signal "1121—3—1122—333," would indicate that "W" was the adjustment-letter and "1122" the cipher combination. The disk would in that case be arranged as follows: "W" would be brought to coincide with "1122."

#### IV.—TO SEND A MESSAGE IN CIPHER.

Station "A" calls station "B," and gets "B's" acknowledgment. "A" gives "B" the cipher combination in which he intends to send the message. Example: "A" gives "B" "2122 (right, left, right, right), 333;" "B" answers by repeating "22.22.22.3,—2122 333;" which indicates to "A" that "B" has got the correct cipher. "A" and "B" adjust their disks as follows: each turns the inner disk so that the letter R will coincide with the combination "2122" in the outer disk. (See Plate XXVI, Fig. 1.)

The disks of both parties are now alike, and the message commences.

To signal the word "Pickets" in the foregoing cipher, station A would make "221 11 1221 2211 1212 211 122, 3,"=Pickets. If "W" was the adjustment-letter and "1122" the cipher combination, then "W" would coincide with "1122," and the word "Pickets" would be represented by "122 1211 212 2 2222 112 2111, 3,"=Pickets.

#### V.—TO CHANGE THE CIPHER WHEN SENDING A MESSAGE.

Officers sending a message of an important nature from a point that is supposed to be watched by the enemy, will change the cipher while sending the message.

The change of the cipher combinations will be made at the close of a sentence or of a word.

Example: Suppose the first part of a message is sent with "D" for the adjustment-letter, and adjusted at 112 for the cipher combination. At the close of the first sentence, the officer sending will make the signal "33—121—33," which will indicate, to the officer receiving the message, that the cipher is to be changed from "112" to "121;" each officer will adjust his disk, that is, he turns the inner disk, so that the letter "D" will coincide with "121" instead of "112" as before.

The officer receiving the message will acknowledge that his disk is readjusted by making "121, 333." The officer sending the message will now continue the message in the new cipher.

Any number of changes can be made in the same manner.

## VI.—RECORD.

The officer receiving the message will have another officer or an enlisted man to write down the combinations as they are received, each being called off in its turn by the person at the glass. At the close of the message the officer will take his disk and decipher or translate the combinations thus written, acknowledging the receipt of the message in the usual manner.

It will be understood how different parties, aware that they have similar disks and furnished with such rules, may telegraph in cipher and change the cipher frequently in every message upon their first meeting. The instructions given are of a general character. There should be, in addition, especial instruction of a confidential nature.

There are certain preconcerted plans for arranging or using the disks in a particular manner. These may issue from a central office, and should be committed to memory

by those entitled to receive them, so that, in case of capture, no information will fall into the hands of the enemy.

In the presence of an enemy, where changes of cipher must be constant, the senior signal-officer should issue confidential instructions by which a cipher, peculiar to his party, is to be used and changed. When stations are much exposed and of great importance, an especial cipher, intelligible to the officers upon those stations only, may be issued to them.

Skilled signalists can, at any time, concert for their own use a cipher which will be uninterpretable by others.

The Roman characters may be used for numerals with the cipher disk. They are to be preceded and followed by signals for "numerals follow" and "numerals ended."

Disks intended to be used exclusively as cipher disks should have upon the inner disk a character for "end of a word," with a corresponding symbol upon the outer disk. (Plate XXVI, Fig. 4.)

A message sent in cipher with such a disk shows no clue for the beginning or end of words. The apparent terminations made when the signal "three" is shown for a letter, only mislead the interpreter.

A plan for a General Service Disk is as illustrated in Plate XXVI, Fig. 4. It consists of one interior and one exterior disk; the interior bearing upon it letters, etc., and the exterior prepared with rows of signal-symbols—one of a code of two elements, one of a code of three elements, and one of a code of ten elements. An additional row of letters may be printed upon the outer disk, to permit a message to be readily enciphered in letters instead of signals, when that is desirable.

Using this disk, messages can be sent enciphered by any plan of signals which has been described in these notes. Or they can be written out to be sent by mail, or messenger, or by electric telegraph.

Disks can be used with frequent changes of adjustment-letters, as described in General Rules. Or preferably by the plan of countersign-words or countersign-figures.

They can be modified in any of the modes hereafter described, to add to the safety of the cipher.

#### COUNTERSIGN-WORDS.

The use of countersign-words is a method for securing secret communication. In a Manual prepared for general circulation, the modes reserved for confidential instructions cannot be given. The following are sufficient for illustration, and for general uses.

Countersign-words are key-words by which changes of adjustment are so regulated as to be made by rule, the countersign-word rendering it possible to remember numerous changes, and to preconcert that similar changes be made at similar times, by similar rules, by a number of signalists.

Countersigns may consist of one word or of several, as "Baltimore," or "Germanic hosts." The fewer repetitions of any letter in a countersign the better. When countersign-words are used, each letter of the countersign becomes, in its turn, the adjustment-letter. The changes, from letter to letter, are indicated by preconcerted signals. The key-number, to which the first adjustment is made, is either prearranged or it is conveyed by secret signals.

Cipher Disks can be made for practice, and ought to be used by the student to verify the illustrations which follow. The disks are to be cut from writing-paper or thin cardboard; they are concentrically fastened together with a pin, or any simple pivot, and bear copied upon them the letters, characters, and division lines as given in Plates XXVI and XXVII.

Messages to be sent in cipher may be reduced to writing in cipher before they are transmitted.

Enciphered messages are sometimes reversed. The last letter of the last word is in this case signalled first, and is followed by the other letters of the word, and the other words in this reversed succession :

Thus the sentence,

“Do not come here,”

Signalled reversed would read,

“ereh emoe ton od.”

Or the words may be written and reversed in clauses, as by twos, by threes, or other number together at will.

So, “Do not—come here,”

would be, “Ton od—ereh emoe.”

This simple device adds much to the labors of a decipherer, and does away with any clue from context.

When a message is to be written enciphered, it is first written out in full. If it is to be enciphered by clauses of two or more words each, it is then so divided. The letters of the countersign-words are then written letter by letter over each word or each clause. The message is then enciphered by reference to the disk, adjusting the letters over each word or clause in turn to the key-number or key-letter.

If the message is to be inverted, either as a whole or by clauses, it is so inverted before the countersign-letters are written over it.

When a message is to be *enciphered*, the correct letters, etc., are sought on the *inner* disk, the cipher-letters or symbols are opposite and coincident upon the *outer* disk.

When a message is received in cipher, it is determined, first, whether it is inverted; then, whether it is divided by words or clauses. These facts will be known by the preconcert and by the record. The letters of the countersign-words are then written over the words or the clauses, and the message is interpreted by reference to the disk adjusting the letters written over each word or clause to the key-number

in turn. When the message as received is continuous and without division into words or clauses, the interpretation is commenced by adjusting the first letter of the countersign-word to the key-number; the first "end of word" signal then found in the message will indicate the first change of cipher—*i. e.*, the second letter of the countersign-word is then to be brought to the key-number; and so for each change in succession.

When a message is to be *deciphered*, the cipher-letters or symbols are found upon the *outer* disk; the correct letters, etc., are opposite and coincident upon the *inner* disk.

The same rules apply when a message is to be enciphered in or deciphered from signal-numbers.

In the examples which follow, the messages are enciphered in letters. This mode is the more convenient, and best illustrates the changes and the safety of the cipher.

Such examples assume that the enemy know what signals signify each letter of the alphabet. The message remains incomprehensible. The reader will comprehend that the signal-numbers could have been given, changing in each cipher-change, instead of the changing letters here exhibited.

The cipher-disk can be used with countersign-words: the "pause-signal" being used to indicate the times at which the cipher is to change. The "countersign-words" may consist of either one word or several, as "Mohican" or "Albon City."

If the countersign "Mohican" is to be used, the key-number of the disk being, say "11," then at the commencement of the message the letter "M" would be at "11;" the first two words of the message would be signalled with this key, a combination-signal being used as the "end of word" signal to indicate the pause or space between the words. At the end of the second word the "front" signal being made, indicates at once the end of the second word and change-cipher. The second letter of the countersign-word,

the letter "o" on the disk, is brought to the key-number "11." The next two words, the third and fourth words of the message, are signalled in this cipher. Another "front" is then made; the letter "h" is to be brought as the adjustment-letter to the key-number—in which are sent the fifth and sixth words of the message, and thus to the completion. In the record of a message so sent, a dash marks each change of the cipher. The countersign-word, known to the decipherer, furnishes the clue for the interpretation. In emergencies, a skilful person in charge of the disk decipherers the message letter by letter as it is received by signal.

For example, the words of the message,

m		o		h		i		c
---	--	---	--	---	--	---	--	---

"The enemy | have crossed | the river. | Send a | cavalry  
                   a                  n  
 force | to their | rear,"

are set off by twos as here given, and the countersign-letters are written over each clause. Disk as at Plate XXVI, Fig. 2. Countersign "Mohican."

Key-number "122," or key-letter "N."

The message is signalled,

"Fiv gvevnh grpingzusnddingk ningk qnfocezf. udr—  
 &qnjdjitefintnz ingijingtonrwp lqfl."

If the message had been inverted, the countersign-letters would have been written over the clauses, commencing "m" over the last clause, thus:

n		a		c		i		h
---	--	---	--	---	--	---	--	---

"The enemy | have crossed | the river. | Send a | cavalry  
                   o                  m  
 force | to their | rear."

The last letter of the message would be signalled first, and followed by the other letters and words in reversed succession, thus:



"Ztvz s&inggezne fsetmo-epvzvs q&-rdn tzdstxzhe urqipajr—ntion pingqnqwrd."

If the end of every word is marked by a signal combination, the clauses may terminate and the cipher change sometimes in the middle of a word, the pause-signal signifying the change.

A combination signal should never be used for the end of a word, unless with precautions similar to those above described; for occurring so frequently in each message, it will afford the enemy, if by chance a cipher-disk happens to be in his possession, the key by which to adjust it.

---

If a cipher-disk has upon it codes of different elements, as, for instance, codes of two, three, and ten elements, then messages may be sent with the general rules; but the letter-signals changing from those of one code to those of a code of different elements at a certain signal, thus working with a code of two elements by flag motions, the letter "A" may appear in one word as "two-two"—"22," while in the next word, the change-signal being given, it may appear as "three three"—"33." The changes from code to code are indicated thus: "33—2—33" "Use code of two elements;" "33—3—33" "use code of three elements," and so on. Working with signals by positions and motions, as with disks, numerous codes may be thus used in the same message. Thus "33—5—33" means "Use code of five elements;" "33—7—33," "Use code of seven elements." The record carefully kept, and noting each change, will give the clue to the interpretation.

## ENCIPHERING CERTAIN WORDS ONLY OF A MESSAGE.

It is one plan of cipher to place certain words only of the message in cipher characters—the other words are transmitted as written. Thus with a cipher-disk and a certain adjustment-letter or countersign-word, the key-letter being given, the message may be signalled with all the nouns and leading verbs in cipher, or with such words in cipher as will cover all clue to the meaning of the message. The ciphered words, if few in number and with few recurring letters, may be signalled with one adjustment of the disk.

If the ciphered words are numerous, it is well to change the adjustment-letter for each, or a countersign-word may be used. In this case the first ciphered word is transmitted with the disk adjusted by the first letter of the countersign, the second word the disk adjusted by the second letter of the countersign, and so on. When the countersign-word has been once used, the next cipher word commences with the disk again adjusted by the first letter of the countersign, and so on. The signal "the following word is in cipher" may be made by three circular waves of the flag from left to right, or by other agreed signal. If more than one word is enciphered, this signal should be made both before and after the words. In cases where this signal is omitted, the fact that the ciphered words alone are unintelligible will indicate to the receiver that he must refer for them to his key and cipher. This plan has the advantage, that the ciphers are so short that rules for deciphering will not apply.

If two or more words are employed together, signal combinations appearing on the Disk and meaning "end of word" being used instead of the usual intervals between the words, to show where each word is ended, there is no clue

to the number of letters in any word, and it becomes yet more difficult to correctly interpret the message.

For example, the message :

“Troops cannot be spared to re-enforce you to-morrow,” enciphered with disk (Fig. 2, Plate XXVI), the first and second letters of the message, “T” and “R,” being taken respectively as the “adjustment-letter” and the “key-letter,” reads :

“Troops xiwermgmnfji—na to reenforce you to-morrow.”

---

In the methods of cipher before described, the division of the message into words or into clauses of greater or less length affords a possible aid to the interpreter. A more difficult cipher is this: the disks are prepared as usual. It is understood that the “front” signal is no longer to indicate a pause or clause, but that it, like any other signal, is to represent a letter as often as a letter on the interior disk has this signal coincident with it upon the exterior disk.

Any combination may stand for the end of a word.

A countersign-word or sentence is concerted.

The disk is adjusted at particular letters by preconcert.

The transmission is commenced by signalling the first letters of the message with the first letter of the countersign-words at the key-letter. When the combination signal—which, with the disks at this adjustment, stands for “end of a word”—is made, it indicates at once the end of a word, and is the signal to change the adjustment of the disks; and the second letter of the countersign-word is brought to the key-letter—the signalling proceeding without any marked pause; the next following letters are sent with this key until that signal, which with this adjustment stands for “end of a word,” is made, when the adjustment is again changed and the third letter of the countersign-word is

brought to the key-letter—and thus on, the adjustment changing at each combination standing for “end of a word,” until all the letters of the countersign-words have been used; when for the next adjustment the first letter of the countersign-word is again used, repeating the process as before.

The result of this management is, that the message is signalled with the letter-signals changing wholly in each word and without clue to the beginning or end of any word, the record presenting from the beginning to the end a continuous line of combinations or of letters. The decipherer is so deprived of almost every clue upon which experts rely for their interpretations.

The record is still further complicated for the interpreter, by the fact that the signal “front” generally indicates the “end of a word.”

And on the record there may be many “fronts” or “threes.” If the message is divided into words by these signals, it is confused.

For example, the message :

“Gen. U. S. GRANT :

“Allatoona is closely invested, but will hold out until you can relieve it.

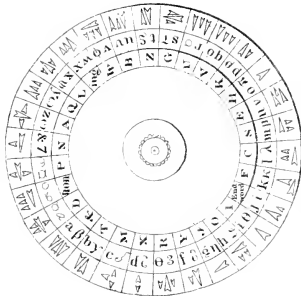
J. F. CORSE, Maj.-Gen.”

So enciphered, Disk as Fig. 2, Plate XXVI, Baltimore being countersign-word, key-letter E reads—

B	a	l	t	i	m	o
G	e	n	-	U	-	S
-	G	r	a	n	t	-
A	l	l	a	t	o	o
n	a	-	i	s	-	c
l	o	s	e	l	y	
k	q	u	a	l	w	y
v	s	r	t	i	o	n
e	z	v	p	p	v	q
t	t	i	v	o	n	u
&	x	y	e	f	n	y
k						
r			e	B	a	l
t						
-	i	n	v	e	s	t
e	d	-	b	u	t	-
w	i	l	l	-	h	o
l	d	-	o	u	t	-
u	n					
m	x	a	i	n	g	h
z	3	h	t	i	o	n
f	&	x	i	c	o	i
s	s	w	w	i	n	g
k	x	l	l	r	z	y
y	t	i	o	n		

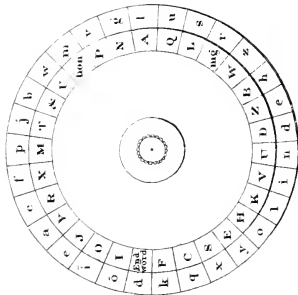


Fig 1.



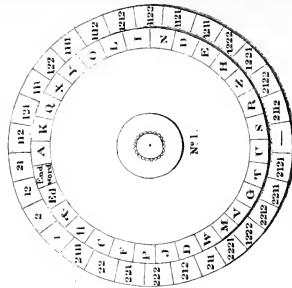
Discs for Cryptographic writing.

Fig 2



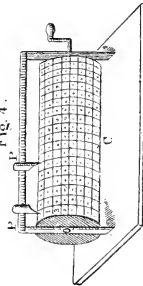
Discs cut from writing paper.

Fig 3.



Seven large & seven small discs joined.

Fig 4.



Cipher Reel.

Fig 5.

Hawley's  
Cipher Tablets.

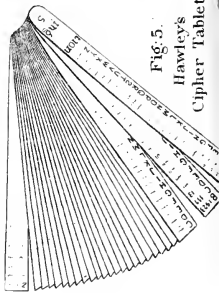


Fig 6



Vertical Section of Fig 3.

i m o r e B a  
 t i l - y o u - c a n - r e l i e v e - i t - J - F - C o r s e -  
 e & a z 3 t h o h q r & 3 n y o n h n m x 3 f q c j w y i n g h v i l  
 l t  
 m a j - g e n  
 h m g y v i n g t i o n

If in addition to this the message is transmitted inverted, commencing the transmission with the last letter of the last word, and so with each in turn until the first letter of the first word is reached—the complication is greater.

A mode of using the cipher-disk similar in effect to the employment of the countersign-word is to have instead an agreed number, or rather combination of numbers; as, for instance, “2 4 6 7.”

An adjustment-letter is selected. This letter is adjusted to any agreed key-number upon the outer disk.

The first word or clause of the message is then transmitted in this cipher. At the signal “front,” the adjustment-letter on the disk is moved forward *two* spaces. The next word or clause is transmitted in this cipher. On the signal front the adjustment-letter is moved forward *four* spaces; and the next clause is so transmitted: for the next change of cipher the adjustment-letter is moved forward *six* spaces, and for the next in like manner moved *seven* spaces. The number “2467” is now exhausted, and for the next change the adjustment-letter moves forward again but *two* spaces, the distance indicated by the first numeral of the combination; for the next change the adjustment-letter moves again *four* spaces; and so on by repetitions.

Plate XXVII, Fig. 1, affords an illustration of a signal-disk prepared for cryptographic writing. Each letter on the inner disk is represented by either of two or more coincident with it upon the outer disk.

In this case the letters of the Roman and Greek alphabets have been used with one or two added signs.

To illustrate with a disk fashioned as above, encipher the words :

h	o	n	e
“Have not—	Have not—	Have not—	Have not
s	t	h	o
Have not—	Have not—	Have not—	Have not.”

Assume a countersign-word, as “Honest.” Adjust H to o.

The countersign-letters are written over the words as above.

The cipher reads :

ozqn 7θb—φcψu δoθ—fñζγ πzς  
 p7rπ σiς—qα·ρ öjδ—αις7 jvπ—  
 πzov 7hy—vςxε dπi.

The spaces between the words are left blank in this cryptogram, to enable the reader to trace each letter. It can, of course, be complicated by using a sign for the “end of word,” and this sign would change for each word.

A more simple cryptogram is made by using the letters of the English alphabet only, as at Plate XXVII, Fig. 2.

Then countersign and adjustment being as above, the cipher reads :

otij gjj—zpsh foō—pyej ote—lgno vōp—ivdl mdf—vōwg  
 dho.

In this, as in the preceding case, the spaces at the ends of words are left blank. If more repetitions of the same words were to follow, with no letter twice alike, a longer countersign would be necessary. For forming cryptograms of this style, any signs can be used and any number of them placed in each compartment of the exterior disk, and so made coincident with any letter upon the interior disk. Thus the



spaces upon the exterior may inclose cuneiform characters, or Greek or Hebrew letters, or any character or signs ingenuity can devise.

Disks of this kind can be easily made: the forms cut from writing-paper. They can be lettered at the option of those who are to use them.

This style of cryptogram may thus be useful to officers whose communications must be confidential, and who—each provided with a disk, an agreed countersign, and key-letter—can communicate in a cipher not likely to be interpreted.

The changes to be had with cipher-disks by changing the sequences of the letters of the alphabets; by changing the sequences of the signal-symbols; by changes of adjustment; by changes of structure and of plans for use, are infinite.

Changes by Adjustment are all those changes which can be had by using the different letters of the alphabet as adjustment-letters, and by adjusting them to correspond with different signal-symbols or key-numbers.

A principal way of effecting changes by countersign-words has been described.

Countersign-words may be of every variety. A sentence of long words is sometimes chosen as a countersign. Any words which can be remembered can be strung together for this purpose.

A number of countersigns may be prearranged and numbered, and it may be concerted that certain countersigns shall be used on certain days of a month, or of a week, or there may be a number of countersigns noted by numbers; and the preconcert that a certain countersign shall be used with the first message; a different countersign with the second; still another with the third; and thus on.

When countersigns are prearranged by certain rules, and General Service Disks are distributed to the different posts and to certain officers of a command, a secret correspondence in writing can be had with any post on any day, or com-

munication can be had to or from any post in view by secret signals.

A disk without the countersign, or a countersign without the disk, is useless in the hands of an enemy.

Stations being provided with similar disks, countersigns may be signalled from station to station if there be no other alternative. This must be with precaution. Thus it may be understood that the first name of a person signalled in any message, between two parties wishing to establish a countersign, shall be the countersign. This clue had, another countersign can be established.

The characters upon the inner disk may vary. They may be more numerous than in the illustrations given. (Plates XXVI and XXVII.) There may be, in addition to the alphabet, characters for "periods," "commas," "message is addressed," "message is signed," "numerals follow," "numerals ended," etc., etc., and for numerous combinations of letters, as *ed*, *ous*, *ly*, *tive*, *the*, etc., etc., and the double letters, as *mm*, *ll*, etc. For each of these an additional signal-symbol must be arranged to correspond upon the outer disk. There can be thirty signal-symbols of two elements, using up to those of four places. There are eighty-one signal-symbols of three elements, using up to those of four places. The number of symbols increases as those of greater numbers of elements are used. The disks must be kept of convenient size. Each additional character and symbol adds to the safety of the cipher.

There may be several rows of signal-symbols of differing numbers of elements upon the outer disk; as Plate XXVI, Fig. 4.

The example is of two, three, and ten elements; there might be additional rows. This example will enable it to be understood how several distinct signals may each of them stand for the same letter; or how, by similar plans, several distinct signs or characters may be made to represent the

same letter in a cryptogram. With but three rows, as here given, each letter, etc., upon the inner disk can be signified by nearly one hundred different signals; or, in a cryptogram, it could be written with nearly a hundred different characters.

Supposing the letters, etc., on the inner disk to be thirty in number, and nine rows of symbols on the outer disk, each letter could be represented in two hundred and seventy different ways. Some instances of this kind are already illustrated.

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There may be several disks concentrically joined. Thus there being furnished a large number of inner disks, made of thin cardboard, and each having printed upon it the alphabets, etc., but with a different sequence of the letters on each card, a number of these are clamped together, one on top of the other, in the place of a single inner disk. (Plate XXVII, Fig. 3.) These inner disks have numbers stamped upon them, and they are known as numbers "one," "two," "three," etc., counting from above. If, now, it is at any time desired to change the sequence of the alphabet, a signal is made—"disk three," "disk nine," etc., as the case may be. Disk "three" or disk "nine" is then brought to be uppermost, and the signalling proceeds under the same rules of working as before. A copy of any disk is thus useless in the hands of an enemy.

Or it may be arranged that a certain numbered interior disk shall be used on each day of the week or of the month, and that the interior disk shall change thus every day. Thus, with seven interior disks, it may be arranged that number one shall be used on Sunday; number two on Monday; and so for the succeeding days of the week.

There may be also several exterior disks; and then it can

be preconcerted to wholly change the disks as often as is desirable. (Plate XXVII, Fig. 3.)

The number of changes that can be had in this manner are all those that can be had by all the changes of sequence that can be made with all the characters that may be used upon the interior disk, added to all those that can be made with all the symbols that may be used upon the exterior disks. They are some millions.

The signal-disks may thus be used with an endless variety of structure and application. The modes here given are perhaps sufficient for illustration.

The possible utility of the device will be realized when it is considered that in the hands of any signalist it affords him at once the means to communicate in codes he may have never learned, and the modes *to guard* his communications from detection. With disks, on which are printed different codes with brief instructions as to the use of the disk, there are furnished, in a simple form, all needed rules and apparatus for forming codes of signals and for making them secret,—a compend of the principles and practice of telegraphic signalling and of cipher.

Every signal-officer, and indeed every well-educated officer of the Army and Navy, ought to have such information as will enable him to use the signal-disks. A few days' study will render this practicable.

When we reflect how skilfully a message may be concealed in written cipher; and again, that that message signalled is yet further concealed, for the reason that even the letters of the copy can be then arrived at by the signalist only who receives them and who possesses the key to the disks: when we remember how varied the meanings of the signals may be; that different disks may be used at different times; that different key-words and different adjustments may be used for different messages; that almost every aid by which interpreters are taught to trace may be

taken away; and that at last a mass of letters may be so thrown into the hands of the observer that he may arrange them into whatever divisions his fancy dictates without any clue to their correct arrangement:—the chances of interpretation appear so small as to give the assurance of safety.

The instructor and the pupil must remember that, in this branch of signalling, the highest skill comes only with persevering practice.

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A single Cipher Disk made of brass, and having the letters separately detachable, in order that their sequence may be at option altered, has been prepared by Mr. J. WYATT REID, of New York.

Mr. REID was one of the first to thus illustrate the ease with which the sequences of the alphabetic letters might be changed, and the importance of such changes.

Greater convenience and safer results are, however, had by the use of the disks, movable upon each other, as has been heretofore described.

---

A very ingenious and valuable plan of cipher has been devised by Sergeant EDWIN H. HAWLEY, of the Signal Corps. The apparatus consists of twenty-six long and narrow tablets fastened together at one end, arranged as the tablets or strips of some kinds of wooden fans. On each tablet is inscribed an alphabet and the numeral signals for its letters, and the combinations of letters generally used. The alphabets are so arranged that the alphabet on the first strip commences with the letter A and its signal at the top of the strip; the letter B and its signal are at the top of the second strip, and so on. In enciphering a message, a countersign-word being given, the alphabets and signals upon these

tablets are used, each being taken in such sequences as are indicated by the letters of the countersign-words.

For illustration: Suppose the countersign-word to be *Act*, the word to be enciphered, *Board*; then the numeral signal for the letter *B* is sought on the tablet commencing with *A*, the signal for *O* is sought on the tablet commencing with *C*, the signal for *A* on the tablet commencing with *T*. The key-word, *act*—*a-c-t*—has now been once used; so, for the signal for the letter *R*, we return to the tablet commencing with *A*, and the signal for *D* is sought on the tablet commencing with *C*. The signal to indicate the close of a word is sought on the tablet *T*. The signal for the first letter of the next word is found on the tablet *A*; and so by repetitions of the process the message is completed.

The resulting message presents no distinguishing marks by which the end of address or ends of words can be detected, and no character need be twice presented by the same signal. This apparatus is compact, the plans for working it are easily understood, and it affords a simple and very effective cipher. (Plate XXVII, Fig. 5.)

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An ingenious arrangement has been proposed by Private JOHN C. ANTON, of the Signal Corps. The alphabets, with the numerals and whatever abbreviations are to be used, are inscribed upon a single card. (See page 309.)

The description of this card or disk, and the manner of using it, are given in the language of the inventor:

“The disk should be made of enduring material, either tin or leather: the latter is, I think, the best, because it is light and pliable, and if put between the leaves of a book it bends easy with the book.

“The first horizontal column of the disk shows the signal-numbers: the alphabets below it should be separated from it

[illegible]

by a broad line, to distinguish them, and each one of a different color, from the first and each other.

“The vertical lines should be of a different color from the horizontal lines and letters, and heavy, to facilitate the finding of a corresponding number to a letter, or *vice versa*.

“Below the alphabets are the figures, and a column for signals used, consisting of several words.

### “TRANSMISSION OF A MESSAGE.

“After communication is established, the number opposite any one of the alphabets should be flagged; it indicates the alphabet which should be used first to find the 1st letter;

but it may be agreed, that in case the number of the alphabet should not be flagged, the first horizontal column will be always used to begin with.

“To find the 2d letter of the word, the next alphabet below it should be used, and so on successively; after the last one, the alphabet first on the card will be the next to be used, then the 2d, 3d, 4th, 5th, and then the first one again. At the end of each word the signal-number over the short heavy line before the “A” indicates the end, the same as 5 formerly. To indicate the end of a sentence, that number should be flagged twice.

“If figures occur in the message, or any of the abbreviations, the number on the left side for the columns of the figures and abbreviations 333 and 444, or any others not among the signal-numbers on the disk, must be flagged first; and after the figures are sent, the same number again, to indicate that letters will be flagged again. After sending figures or abbreviations in a message, it may be agreed either to commence with the first alphabet again for the 1st letter, or to continue with the next alphabet to that one last used before the 1st figure or abbreviation was flagged; in that case the finger ought to be held on the last used alphabet until the figures have been sent. It is obvious that the signal-numbers for a figure or an abbreviation will be always the same on this disk; if that should be objectionable, a disk which has the signal-numbers instead of letters in the 5 horizontal rows and the alphabet on the top, would answer the purpose. By using this disk and flagging figures or abbreviations, another row of signal-numbers should be used for each following figure or abbreviation, the same as if flagging numbers for letters; but the number 444 or 333, opposite the two lower rows, should not be omitted to be flagged, before flagging them, the same as with the other.”

By the use of this card results similar to those attained by the plan of Sergeant HAWLEY are had.



This form of cipher card has the advantage of simplicity of structure, and of the fact that a card can be at any time prepared by the signalist who may need it. It can be easily carried in a Field Book.

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## ROUTE CIPHERS.

Messages may be enciphered by Route Ciphers, to be sent by messengers or to be telegraphed by signals.

Route Ciphers are those in which the words of the message are retained unchanged, but so disarranged by concerted rules that the message becomes unintelligible.

The message as received seems to be a number of disconnected words and without meaning. These words, arranged in a certain order by certain rules, convey a perfect message. A common mode of forming route ciphers is to form the words of the message in columns. A route, as it is called, is issued to the correspondents thus:

“Form to be four columns, four words each. Route: *Down* the first column; *up* the fourth; *down* the second; *up* the third. Fifth word blind.” A set of columns being drawn—as,



write the words of the message given in their proper sequence, *down* in the first column, *up* the fourth, *down* the second, and *up* the third.

The message must be of a certain number of words, so as to exactly fill, for instance, four columns of four words each.

If the message, as written, is not of this length, there must

be added to it some words having no meaning, or a meaning irrelevant to the subject of the message. Thus a military message may be eked out with a sentence; as, "The wheat crop is doing well," or, "The steamer Africa has just arrived."

Points of punctuation are written in the columns with and just after the words they follow in the copy.

In some cases blind words, as they are called, are added to the message. These are words added to the message to confuse it; thus, every fifth or every sixth word may be a *blind word*, and they may be so managed as to wholly pervert the meaning. Blind words are inserted in the copy as the message is being written out in cipher from the columns in which it is first formed. To decipher such a message, reference is had to the instructions for the "Route."

A message being received, the blind words, found by their location, are stricken out; the remaining words are then set off by sets—the number of words in each set being equal to the number of columns given in the "Route." A number, as No. 1, No. 2, No. 3, etc., is given to each word in each set. A corresponding figure is written over each word. The words are then placed in columns;—all the No. 1 words in the first column; the No. 2 words in the second column; and so on.

After the words are so arranged, they are read or written in the order prescribed by the "Route."

To encipher, by the "Route" given above, the following message:

"The enemy has changed his position during the night. Deserters say that he is retreating"—

The words of this message placed, one after the other, in four columns—four words in each—and *down* the first column, *up* the fourth, *down* the second, and *up* the third, are as follows:

## COLUMNS.

1st.	2d.	3d.	4th
The	night.	Smith	the
enemy	Deserters	retreating	during
has	say	is	position
changed	that	he	his

The instruction in this "Route," "every fifth word blind," means that every fifth word in the cipher is a word added to confuse. These words are chosen arbitrarily.

The message formed above is written—reading across the columns and adding a blind word to every four above given—thus:

"The night. Smith the attacking enemy Deserters retreating during summer has say is position unchanged changed that he his him."

The words "attacking," "summer," "unchanged," "him," are the blind words added.

The communication is now ready to be transmitted by messenger or signals.

To decipher this message, having the route as above given:

1st. Every fifth word is stricken out as blind, thus—

The night. Smith the *attacking* enemy Deserters retreating during *summer* has say is position *unchanged* changed that he his *him*.

2d. The remaining words are told off by fours, that being the number of columns given—thus:

1 The	2 night	3 Smith	4 the
1 enemy	2 Deserters	3 retreating	4 during
1 has	2 say	3 is	4 position
1 changed	2 that	3 he	4 his

3d. Formed in this manner the words are in columns, and the message is read: Down the first, up the fourth, down the second, and up the third; giving the original message:

“The enemy has changed his position during the night. Deserters say that he is retreating.”

As an additional complication, it is customary to leave in the possession of each correspondent a dictionary or code in which the names of all prominent generals or places, and many of the prominent verbs—as to march, to sail, to encamp, to attack, to retreat—are represented by other words. Thus, General Grant may be known as Ironsides; Sherman as Lightning; Washington may be Queen City; “to march” may be “to halt,” and so on.

The message so guarded falling into the hands of an enemy is unintelligible, even though it were possible to correctly arrange the dislocated words.

The following message is another example:

“What are the enemy doing? I shall move all my artillery to-night, and shall attack at daylight. Send me one thousand cavalry, four thousand infantry, and all the provisions you can spare.”

Form to be 6 columns, 6 words each. Route—Up 1st column, down the 3d, up the 2d, down the 5th, up the 6th, down the 4th.

Lay off the form 6 columns, 6 spaces in each column. Commencing at the foot of the first column, write the first six words *up* that column; the next six words are to be written *down* the 3d column, the next six are to be written *up* the 2d column, the next six *down* the 5th column, the next six *up* the 6th column, and the remaining two *down* the 4th column.

The message so written stands thus—the words “Jones is very sick,” being added to fill out the 4th column:

	1	2	3	4	5	6
1	I	send	shall	can	me	you
2	doing?	daylight	move	spare	one	provisions
3	enemy	at	all	Jones	thousand	the
4	the	attack	my	is	cavalry	all
5	are	shall	artillery	very	four	and
6	What	and	to-night	sick	thousand	infantry

Removed from the columns, it reads: “I send shall can me you doing? daylight move spare one provisions enemy at all Jones thousand the the attack my is cavalry all are shall artillery very four and what and to-night sick thousand infantry.”

To decipher, the words are placed again by sixes in columns, and being read according to the Route, the message is correctly had.

1 I	2 send	3 shall	4 can	5 me	6 you
1 doing?	2 daylight	3 move	4 spare	5 one	6 provisions
1 enemy	2 at	3 all	4 Jones	5 thousand	6 the
1 the	2 attack	3 my	4 is	5 cavalry	6 all
1 are	2 shall	3 artillery	4 very	5 four	6 and
1 What	2 and	3 to-night	4 sick	5 thousand	6 infantry

The instructions for a Route Cipher to be sent by a messenger may be obscurely written thus:

1st    2d    6th    .....5th  
       3d    5th    4th

may be read, "Read 1st up, 3d down, 2d up, 5th down, 6th up, 4th down," as the numbers are above or below an imaginary line. The figure standing *on* the line is read "5th Blind."

The Forms, the Routes, and the dispositions of the Blind Words may be varied infinitely.

The forms may be of any number of columns, and any number of words in a column. Thus, the Form may be six columns—two words in each column; or three columns—five words in each column; and so for any changes. The Routes

and the distribution of the Blind Words are any that ingenuity may devise.

The cipher is interesting from the fact that messages can be so formed as to convey, when read in cipher, a meaning the reverse of that which is had when they are correctly interpreted.

By numbering the words in Webster's Dictionary, and by making the number of any word by signals, using any kind of code, any word or words may be signalled entire. These numbers written on paper would be a good cipher. The words in Naval Vocabularies or the sentences in Signal-Books may be numbered or signalled after this fashion. By extending arrangements of two elements to about fifteen places, a separate signal may be had for each word of the English language. Now if a dictionary is made polyglott, all the words of any language may be signalled by each word being symbolized by a single arrangement. There are thus spaces between words only, and so greater brevity. The sentences in Naval Signal-Books may have such indices set for each.

Page 318 exhibits a form of cipher used by the rebels at Vicksburg, and afterward generally in their service during the war of the rebellion. The letters of the Alphabet, as there arranged, are to be written upon a card.

To conceal a message, the rules given on page 319 are to be observed. A word or words known as key-words are adopted: these are furnished in instructions to the officer to use them. Then under each letter of the message to be sent write the letters of the key-word, repeating it as often as the number of letters in each sentence of the message requires, and always commencing a new sentence with the first letter of the key-word. Find in the table the first letter of the message perpendicularly under the letter A; then find the first letter of the key-word horizontally opposite A. The letter at the intersection of the horizontal and perpen-

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
B C D E F G H I J K L M N O P Q R S T U V W X Y Z A  
C D E F G H I J K L M N O P Q R S T U V W X Y Z A B  
D E F G H I J K L M N O P Q R S T U V W X Y Z A B C  
E F G H I J K L M N O P Q R S T U V W X Y Z A B C D  
F G H I J K L M N O P Q R S T U V W X Y Z A B C D E  
G H I J K L M N O P Q R S T U V W X Y Z A B C D E F  
H I J K L M N O P Q R S T U V W X Y Z A B C D E F G  
I J K L M N O P Q R S T U V W X Y Z A B C D E F G H  
J K L M N O P Q R S T U V W X Y Z A B C D E F G H I  
K L M N O P Q R S T U V W X Y Z A B C D E F G H I J  
L M N O P Q R S T U V W X Y Z A B C D E F G H I J K  
M N O P Q R S T U V W X Y Z A B C D E F G H I J K L  
N O P Q R S T U V W X Y Z A B C D E F G H I J K L M  
O P Q R S T U V W X Y Z A B C D E F G H I J K L M N  
P Q R S T U V W X Y Z A B C D E F G H I J K L M N O  
Q R S T U V W X Y Z A B C D E F G H I J K L M N O P  
R S T U V W X Y Z A B C D E F G H I J K L M N O P Q  
S T U V W X Y Z A B C D E F G H I J K L M N O P Q R  
T U V W X Y Z A B C D E F G H I J K L M N O P Q R S  
U V W X Y Z A B C D E F G H I J K L M N O P Q R S T  
V W X Y Z A B C D E F G H I J K L M N O P Q R S T U  
W X Y Z A B C D E F G H I J K L M N O P Q R S T U V  
X Y Z A B C D E F G H I J K L M N O P Q R S T U V W  
Y Z A B C D E F G H I J K L M N O P Q R S T U V W X  
Z A B C D E F G H I J K L M N O P Q R S T U V W X Y



dicular columns, starting from the two letters thus found, will be the cipher-letter to be written in place of the true letter.

The same process is required for each letter, until the message becomes complete.

To interpret such a cipher the process must be reversed. Write as before the letters—the letters of the key-word under those of the cipher; take the first letter of the key-word in the table opposite A, and trace down that column till the first letter of the cipher is found; the letter opposite this, and perpendicularly under A, will be the first letter of the message; and so on until the message is complete.

#### ILLUSTRATION.

The key-word being “complete victory,” to encipher the message “the army will move to-night.” Writing under the letters of the message the correspondent letters of repetitions of “complete victory,” we have:

T	h	e		a	r	m	y		w	i	l	l		m	o	v	e		t	o	n	i	g	h	t	.
C	o	m		p	l	e	t		e	v	i	c		t	o	r	y		c	o	m	p	l	e	t	.

Taking T at the side of the table and C at the top, and following the columns in which they are to their intersection, we find the letter V. Record this as the first letter of the cipher message. Then take H at the side and O at the top; we find at the intersection V. Record this as second letter of the cipher. Taking E at the side and M at the top, we have at the intersection the letter Q as third letter of the cipher. The word “the” is thus in cipher “v v q,” and is so written. The words of the whole message enciphered in the same manner become

“v v q-p e q r-a d t n-f e m e-v e z x r l m.”

To decipher this cipher: writing under the letters the correspondent letters of the key-word, we have

“v v q - p c q r - a d t n - f c m c - v e z x r l m.”

C o m - p l e t e v i c t o r y c o m p l e t e .

Finding the letter “C” at the top of the table, and tracing down that column to the letter “V,” we find opposite this letter, at the side of table, and perpendicularly under the letter “A,” the letter “T.” Record this as the first letter of message. Find next the letter “O” at top of table; trace down the column to the letter “V,” and opposite this, at the side of the table, is “H,” the second letter of the message. Find “M,” at the top of the table; trace down the column to “Q,” and at the side is the letter “E.” The word “the” is then found. By such process repeated, the whole cipher is interpreted.

It is a labor to trace out the columns by hand upon the card, and a machine was sometimes used for this purpose. The structure of the apparatus will be understood by reference to Plate XXVII, Fig. 4. The cylinder C was made to rotate easily on its axis, and upon its surface were inscribed the letters in the order given in the card. Above the cylinder was the fixed pointer P and the movable pointer P';—the fixed pointer arranged to bear upon the first column of letters on the cylinder; the movable pointer traversing so as to bear upon any column.

The cylinder being then so placed that the letters of the first horizontal line of the cipher-card come beneath the pointers, and the two indicating letters of the message being determined as in the preceding instance, the movable pointer is moved upon the slide so as to bear upon that indicating letter to be sought at the top or in the first horizontal line of the card. The cylinder is then rotated until the fixed pointer P bears upon the indicating letter to be sought at

the side or in the first vertical column of the card, when it will be found that the pointer P' bears upon the letter at the intersection of the columns, the cipher-letter required.

This machine is equally useful for enciphering or deciphering a message.

A cipher similar in character to that just described, was formed by a kind of mathematical calculation under the following rules:

Commit to memory the alphabet by numbers—viz., A, 1; B, 2; C, 3; D, 4; E, 5; F, 6; G, 7; H, 8; I, 9; J, 10; K, 11; L, 12; M, 13; N, 14; O, 15; P, 16; Q, 17; R, 18; S, 19; T, 20; U, 21; V, 22; W, 23; X, 24; Y, 25; Z, 26.

Take for example the key-sentence "A discovery," and for a message, "Send me powder to-night." Write your message out plainly, thus:

s	e	n	d	m	e	p	o	w	d	e	r	t	o	n	i	g	h	t
1	4	9	19	3	15	22	5	18	25	1	4	9	19	3	15	22	5	18
<hr/>																		
s	h	v	v	o	s	k	s	n	b	e	u	b	g	p	w	b	l	k

Under the message write the figures corresponding to the key-sentence. It will be in this example—viz., a is 1, d is 4, i is 9, s is 19, e is 3 (or third letter of the alphabet); and so on to the end of the key-sentence, repeating when the message is longer than the key-sentence, as in this example.

In rendering a message into cipher you *add* together the number of the key-letter and corresponding number of the message-letter, taking the number of the key one less than is written down. Thus s, is 19,  $19+0$  is 19, or s, the letter to be sent; e is 5,  $5+3$  is 8, the 8th letter of the alphabet is h; n is 14,  $14+8$  is 22 or v; d is 4,  $4+18$  is 22 or v; m is 13,  $13+2$  is 15 or o; e is 5,  $5+14$  is 19 or s; p is 16,  $16+21$

is 37. There being but 26 letters in the alphabet, when the addition exceeds that number, you will find by how many, and the number of the overplus is the number of the letter required. In this instance the overplus is 11 ( $37-26=11$ ), which is the letter K; and so on to the end of the message.

To translate a message, you will *subtract* the number of the key-letter, one less than is written down, from the corresponding number of the cipher message received.

s	h	v	v	o	s	k	s	n	b	e	u	b	g	p	w	b	l	k
1	4	9	19	3	15	22	5	18	25	1	4	9	19	3	15	22	5	18
s	e	n	d	m	e	p	o	w	d	e	r	t	o	n	i	g	h	t

s is 19,  $19-0=19$ , which is the letter s; h is 8,  $8-3=5$  or e; v is 22,  $22-8=14$  or n; v is 22,  $22-18=4$  or d; o is 15,  $15-2=13$  or m; s is 19,  $19-14=5$  or e; k is 11,  $11-21$ . When the minuend is less than the subtrahend, in all cases add 26 (the number of letters in the alphabet) to the minuend, and the remainder will be the number desired in this case:  $11+26=37$ ,  $37-21=16$  or the letter p; and so on to the end of the message.

All that is necessary in this method is to commit to memory the numbers of the letters of the alphabet.

In rendering a message into cipher, *add* the numbers of the message and key-sentence together, always remembering to take the key-number *one less* than is written down.

In translating a cipher message, subtract the key-number from the number of the message, taking the key-number one less than is written down.

In both rendering and deciphering a message, always take the key-number one less than is written down.

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The following article gives, in a pleasant way, so many

of the modes and curiosities of cipher, and so practical an illustration of the deciphering of a cipher message, that it is extracted at length from "Harper's Weekly," December 19, 1863:

### "MODES AND CURIOSITIES OF CIPHER.

"In 1680, when M. de Louvois was French Minister of War, he summoned before him one day a gentleman named Chamilly, and gave him the following instructions:

"Start this evening for Basle, in Switzerland; you will reach it in three days; on the fourth, punctually at two o'clock, station yourself on the bridge over the Rhine with a portfolio, ink, and pen. Watch all that takes place, and make a memorandum of every particular. Continue doing so for two hours; have a carriage and post-horses awaiting you; and at four precisely mount and travel, day and night, till you reach Paris. On the instant of your arrival, hasten to me with your notes.'

"De Chamilly obeyed; he reached Basle, and on the day and at the hour appointed, stationed himself, pen in hand, on the bridge. Presently a market-cart drives by; then an old woman with a basket of fruit passes; anon a little urchin trundles his hoop by; next an old gentleman in blue top-coat jogs past on his gray mare. Three o'clock chimes from the cathedral tower. Just at the last stroke, a tall fellow, in yellow waistcoat and breeches, saunters up, goes to the middle of the bridge, lounges over, and looks at the water; then he takes a step back, and strikes three hearty blows on the footway with his staff. Down goes every detail in De Chamilly's book. At last the hour of release sounds, and he jumps into his carriage. Shortly before midnight, after two days' ceaseless travelling, De Chamilly presented himself before the minister, feeling rather ashamed at having such trifles to record. M. de Louvois took the portfolio with eagerness and glanced over the notes. As his eye caught the mention of the yellow-breeched man, a gleam of joy flashed across his countenance. He rushed to the king, roused him from sleep, spoke in private with him for a few moments, and then four couriers, who had been held in readiness since five on the preceding evening, were dispatched with haste. Eight days after, the town of Strasbourg was entirely surrounded by French troops and summoned to surrender; it capitulated, and threw open

its gates on the 30th September, 1681. Evidently the three strokes of the stick, given by the fellow in yellow costume at an appointed hour, were the signal of the success of an intrigue concerted between M. de Louvois and the magistrates of Strasbourg; and the man who executed this mission was as ignorant of the motive as was M. de Chamilly of the motive of his.

"Now this is a specimen of the safest of all secret communications, but it can only be resorted to on certain rare occasions. When a lengthy dispatch is required to be forwarded, and when such means as those given above are out of the question, some other method must be employed. Herodotus gives us a story to the point; it is found, also, with variations, in Aulus Gellius:

"Histieus, when he was anxious to give Aristagoras orders to revolt, could find but one safe way, as the roads were guarded, of making his wishes known: which was by taking the truest of his slaves, shaving all the hair off his head, and then pricking letters upon the skin, and waiting till the hair grew again. This accordingly he did; and as soon as ever the hair was grown, he dispatched the man to Miletus, giving him no other message than this: 'When thou art come to Miletus, bid Aristagoras shave thy head and look thereon.' Now the marks on the man's head were a command to revolt.' (Bk. v. 35.)

"In this case no cipher was employed. We shall come now to the use of ciphers.

"When a dispatch or communication runs great risk of falling into the hands of an enemy, it is necessary that its contents should be so veiled that the possession of the document may afford him no information whatever. Julius Cæsar and Augustus used ciphers, but they were of the utmost simplicity, as they consisted merely in placing D in the place of A, E in that of B, and so on; or else in writing B for A, C for B, etc.

"Secret characters were used at the Council of Nicæa; and Rabanus Maurus, Abbot of Fulda and Archbishop of Mayence, in the ninth century, has left us an example of two ciphers, the key to which was discovered by the Benedictines. It is only a wonder that any one could have failed to unravel them at the first glance. This is a specimen of the first.

"'.Nc.p.t v:rs:-s B:n.f.c.. rch. gl:r:s.q:-:m:r.t.r.s'

"The clue to this is the suppression of the vowels and the filling of their places by dots—one for i, two for a, three for e, four for o,

and five for u. In the second example, the same sentence would run—Kneckpkt vfrsxs Bpnkf bekk, etc., the vowel-places being filled by the consonants—b, f, k, p, x. By changing every letter in the alphabet, we make a vast improvement on this last: thus, for instance, supplying the place of a with z, b with x, c with v, and so on. This is the system employed by an advertiser in a provincial paper, which we took up the other day in the waiting-room of a station, where it had been left by a farmer. As we had some moments to spare before the train was due, we spent them in deciphering the following:

“ ‘Jp Sjddjzb rza rzdd ci sijmr, Bziw rzdd xr ndzt.’

And in ten minutes read: ‘If William can call or write, Mary will be glad.’

“A correspondence was carried on in the ‘Times’ during May, 1862, in cipher. We give it along with the explanation:

**W**WS.—Zy Efpdobj T dpve l wppee ez mjecp qzc jzf—xlj T daply qfwvj zy lww xleepd le esp tyepegtph? Te xlj oz rzzo. Ecfde ez xj wzgp—T lx xtdpelmwp. Hspj xlj T rz ez Nlyepcmfej tq zywj ez wzzy le jzf.—May 8.’

“This means—‘On Tuesday I sent a letter to Byrne for you. May I speak fully on all matters at the interview? It may do good. Trust to my love. I am miserable. When may I go to Canterbury, if only to look at you?’

“A couple of days later Byrne advertises, slightly varying the cipher:

**W**WS.—Sxhrdktg hdbtewxev “Tmwxqxixdeaxzt” udg pedewtg psktgexhtbtee. QNGCT. “Discover something *Exhibition-like* for another advertisement.—Byrne.”

“This gentleman is rather mysterious: we must leave our readers to conjecture what he means by ‘Exhibition-like.’ On Wednesday came two advertisements—one from the lady, one from the lover. WWS. herself seems rather sensible.

**T**YDEPLO zq rztyr ez nlyepcmfej, T estyv jzf slo xfns mpeepe delj le szxp lyo xtyo jzfc mfdtypdd.—WWS., May 10.

“‘Instead of going to Canterbury, I think you had much better stay at home and mind your business.’

“Excellent advice; but how far likely to be taken by the eager wooer, who advertises thus:

WS.—Fyctw jzfe qlspe lydhped T hzye ldy jzf ez aczgp jzf wzgp xp. Efpdoly yrse le zyp znwzvnslgp l dectyr qczx esp ltyozh qze wpeeped. Tq jzt lep yze lmwp le zyp T htw w hite. Rzo nzxqzce jzf xj olewtyr htqp.

“‘Until your father answers I won’t ask you to prove you love me. Tuesday night at one o’clock have a string from the window for letters. If you are not able at one, I will wait. God comfort you, my darling wife.’

“When the Chevalier de Rohan was in the Bastille, his friends wanted to convey to him the intelligence that his accomplice was dead without having confessed. They did so by passing the following words into his dungeon, written on a shirt, ‘Mg dulhxcelgu ghj yxuj; lm et ulge alj.’ In vain did he puzzle over the cipher, to which he had not the clue. It was too short; for the shorter a cipher letter, the more difficult it is to make out. The light faded, and he tossed on his hard bed, sleeplessly revolving the mystic letters in his brain; but he could make nothing out of them. Day dawned, and with its first gleam he was poring over them: still in vain. He pleaded guilty, for he could not decipher, ‘Le prisonnier est mort; il n’a rien dit.’

“We noticed in a back number of ‘Once a Week’ some verses, or a story, we forget which, signed Azile Nostaw. Did the writer really intend concealing her name by simply inverting it? It was readable at a glance, and she might just as well have signed in the way of ordinary humdrum folk. If, however, you invert a message and *then* turn it into cipher, the difficulty of reading it is greatly enhanced.

“Another method of veiling a communication is that of employing numbers or arbitrary signs in the place of letters; and this admits of many refinements. Here is an example to test the reader’s sagacity:

$$“§\dagger 431\ 45\ 2 + 9 + §51\ 4=3732 + 287\ 45\ 2 + 9\dagger\text{¶} = +$$

“We just give the hint that it is a proverb.

“The following is much more ingenious and difficult of detection:



	A	B	C	D	E	F	G	H
A	<i>a</i>	<i>d</i>	<i>g</i>	<i>k</i>	<i>n</i>	<i>q</i>	<i>t</i>	<i>x</i>
B	<i>b</i>	<i>e</i>	<i>h</i>	<i>l</i>	<i>o</i>	<i>r</i>	<i>u</i>	<i>y</i>
C	<i>c</i>	<i>f</i>	<i>i</i>	<i>m</i>	<i>p</i>	<i>s</i>	<i>w</i>	<i>z</i>

"Now suppose that I want to write *England*; I look among the small letters in the foregoing table for *e*, and find that it is in a horizontal line with B, and vertical line with B, so I write down BB; *n* is in line with A and E, so I put down AE; continue this, and *England* will be represented by *Bbacacbdunueab*. Two letters to represent one is not over tedious; but the scheme devised by Lord Bacon is clumsy enough. He represented every letter by permutations of *a* and *b*; for instance:

A was written *aaaaa*, B was written *aaaab*,  
C was written *aaaba*, D was written *aabaa*,

and so through the alphabet. Paris would thus be transformed into *a'b'bb'a*, *aa'aaa*, *ba'aaa*, *ab'aaa*, *ba'aab*. Conceive the labor of composing a whole dispatch like this, and the great likelihood of making blunders in it!

"A much simpler method is the following:

"The sender and receiver of the communication must be agreed upon a certain book of a specified edition. The dispatch begins with a number; this indicates the page to which the reader is to turn. He must then count the letters from the top of the page, and give them their value numerically, according to the order in which they come, omitting those which are repeated. By these numbers he reads his dispatch. As an example, let us take the beginning of this article: then *I*=1, *n*=2, *u*=3, *h*=4, *e*=5, *m*=3, *d*=7, *l*=8, *u*=3, *r*=10, *o*=11, omitting to count the letters which are repeated. In the middle of the communication the page may be varied, and consequently the numerical significance of each letter altered. Even this could be with a little trouble; and the word 'impossible' can hardly be said to apply to the deciphering of cryptographs.

"A curious instance of this occurred at the close of the sixteenth century, when the Spaniards were endeavoring to establish rela-

tions between the scattered branches of their vast monarchy, which at that period embraced a large portion of Italy, the Low Countries, the Philippines, and enormous districts in the New World. They accordingly invented a cipher, which they varied from time to time in order to disconcert those who might attempt to pry into the mysteries of their correspondence. The cipher, composed of fifty signs, was of great value to them through all the troubles of the 'Ligue,' and the wars then desolating Europe. Some of their dispatches having been intercepted, Henry IV. handed them over to a clever mathematician, Viète, with the request that he would find the clue. He did so, and was able also to follow it as it varied, and France profited for two years by his discovery. The court of Spain, disconcerted at this, accused Viète before the Roman court as a sorcerer and in league with the devil. This proceeding only gave rise to laughter and ridicule."

[This seems to have been a cipher in which each letter of the alphabet was represented by either of two characters. If it had been used with an arrangement similar in effect to the cipher-disk, each letter could be thus represented in one hundred different ways. (See page 305.) It would appear from the text that it was not so arranged as to be varied as frequently as it ought to have been.]

"A still more remarkable instance is that of a German professor, Hermann, who boasted, in 1752, that he had discovered a cryptograph absolutely incapable of being deciphered without the clue being given by him; and he defied all the savans and learned societies of Europe to discover the key. However, a French refugee, named Beguelin, managed, after eight days' study, to read it. This cipher—though we have the rules upon which it is formed before us—is to us perfectly unintelligible. It is grounded on some changes of numbers and symbols; numbers vary, being at one time multiplied, at another added, and becoming so complicated that the letter *e*, which occurs nine times in the paragraph, is represented eight different ways; *n* is used eight times and has seven various signs. Indeed, the same letter is scarcely ever represented by the same figure. But this is not all; the character which appears in the place of *i* takes that of *n* shortly after; another symbol for *n* stands also for *t*. How any man could have solved the mystery of this cipher is astonishing."

[An effect as curious as that here described is illustrated at page 302. And the cipher can be easily written with the aid of the disk. It may be more complicated by increasing the number of characters and adjustments. If, in addition to this, the ends of words, sentences, etc., are concealed, it will add incalculably to the difficulty of the deciphering.]

“Now let us recommend a far simpler system, and one which is very difficult of detection. It consists of a combination of numbers and letters. Both parties must be agreed on an arrangement such as that in the second line on the following page, for on it all depends.

1	2	3	4	5	6	7	8	9	10
4	7	2	9	1	10	5	3	6	8

“Now in turning a sentence, such as ‘The army must retire,’ into cipher, you count the letters which make the sentence and find that T is the first, H the second, E the third, A the fourth, R the fifth, and so on. Then look at the table. T is the first letter; 4 answers to 1; therefore write the fourth letter in the place of T—that is, A instead of T. For h, the second, put the seventh, which is y; for E take the second, h. The sentence will stand, ‘Ayh utsr emmay yhutsr.’ It is all but impossible to discover this cipher.

“All these cryptographs consist in the exchange of numbers or characters for the real letters; but there are other methods quite as intricate which dispense with them.

“The mysterious cards of the Count de Vergennes are an instance. De Vergennes was Minister of Foreign Affairs under Louis XVI., and he made use of cards of a peculiar nature in his relations with the diplomatic agents of France. These cards were used in letters of recommendation on passports which were given to strangers about to enter France; they were intended to furnish information without the knowledge of the bearers. This was the system. The card given to a man contained only a few words, such as:

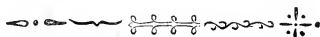
‘ALPHONSE D'ANGEHA.

‘Recommandé à Monsieur

‘le Comte de Vergennes, par le Marquis de Puysegur,

‘Ambassadeur de France à la Cour de Lisbonne.’

"The card told more tales than the words written on it. Its color indicated the nation of the stranger. Yellow showed him to be English; red, Spanish; white, Portuguese; green, Dutch; red and white, Italian; red and green, Swiss; green and white, Russian, etc. The person's age was expressed by the shape of the card. If it were circular, he was under twenty-five; oval, between twenty-five and thirty; octagonal, between thirty and forty-five; hexagonal between forty-five and fifty; square, between fifty and sixty; an oblong showed that he was over sixty. Two lines placed below the name of the bearer indicated his build. If he was tall and lean, the lines were waving and parallel; tall and stout, they converged, and so on. The expression of his face was shown by a flower in the border. A rose designated an open and amiable countenance, while a tulip marked a pensive and aristocratic appearance. A fillet round the border, according to its length, told whether the man were bachelor, married, or a widower. Dots gave information as to his position and fortune. A full-stop after his name showed that he was a Catholic; a semicolon, that he was a Lutheran; a comma, that he was a Calvinist; a dash, that he was a Jew; no stop, indicated him as an Atheist. So, also, his morals and character were pointed out by a pattern in the angles of the card, such as one of these:



So, at one glance, the minister could tell all about his man, whether he was a gamester, or a duellist; what was his purpose in visiting France—whether in search of a wife, or to claim a legacy; what was his profession—that of physician, lawyer, or man of letters; whether he were to be put under surveillance or allowed to go his way unmolested.

"We come now to a class of cipher which requires a certain amount of literary dexterity to conceal the clue.

"During the Great Rebellion, Sir John Trevanion, a distinguished cavalier, was made prisoner, and locked up in Colchester Castle. Sir Charles Lucas and Sir George Lisle had just been made examples of as a warning to 'malignants,' and Trevanion had every reason for expecting a similar bloody end. As he awaits his doom, indulging in a hearty curse, in round cavalier terms, at the canting, crop-eared scoundrels who held him in durance vile, and muttering

a wish that he had fallen, sword in hand, facing the foe, he is startled by the entrance of the jailer, who hands him a letter.

“‘May’t do thee good,’ growls the fellow; ‘it has been well looked to before it was permitted to come to thee.’

“Sir John takes the letter, and the jailer leaves him his lamp by which to read it:

“‘WORTHIE SIR JOHN,—Hope, that is y<sup>e</sup> best comfort of y<sup>e</sup> afflictid, cannot much, I fear me, help you now. That I wolde saye to you, is this only: if ever I may be able to requite that I do owe you, stand not upon asking of me. ’Tis not much I can do; but what I can do, bee you verie sure I wille. I knowe that, if dethe comes, if ordinary men fear it, it frights not you, accounting it for a high honor, to have such a rewarde of your loyalty. Pray yet that you may be spared this soe bitter, cup. I fear not that you will grudge any sufferings; only if bie submission you can turn them away, ’tis the part of a wise man. Tell me, an if you can, to do for you any thinge that you wolde have done. The general goes back on Wednesday. Restinge your servant to command, R. T.’

“Now this letter was written according to a preconcerted cipher. Every third letter after a stop was to tell. In this way, Sir John made out—‘Panel at east end of chapel slides.’ On the following even, the prisoner begged to be allowed to pass an hour of private devotion in the chapel. By means of a bribe, this was accomplished. Before the hour had expired the chapel was empty—the bird had flown.

“An excellent plan of indicating the *telling* letter of a word is through the heading of the letter. ‘Sir,’ would signify that every third letter was to be taken; ‘Dear Sir,’ that every seventh; ‘My dear Sir,’ that every ninth was to be selected. A system, very early adopted, was that of having pierced cards, through the holes of which the communication was written. The card was then removed and the blank spaces filled up. As for example:

“‘MY DEAR X.—[The] lines I now send you are forwarded by the kindness of the [bearer], who is a friend. [Is not] the message delivered yet [to] my brother? [Be] quick about it, for I have all along [trusted] that you would act with discretion and dispatch.

“‘Yours ever, Z.’

“Put your card over the note, and through the piercings you will read: ‘The bearer is not to be trusted.’

"The following letter will give two totally distinct meanings, according as it is read, straight through or by only alternate lines :

'MADEMOISELLE—

'Je m'empresse de vous écrire pour vous déclarer que vous vous trompez beaucoup si vous croyez que vous êtes celle pour qui je soupire. Il est bien vrai que pour vous éprouver, Je vous ai fait mille aveux. Après quoi vous êtes devenue l'objet de ma raillerie. Ainsi ne doutez plus de ce que vous dit ici celui qui n'a eu que de l'aversion pour vous, et qui aimerait mieux mourir qui de se voir obligé de vous épouser, et de changer le dessein qu'il a formé de vous naîr toute sa vie, bien loin de vous aimer, comme il vous l'a déclaré. Soyez donc désabusée, croyez-moi; et si vous êtes encore constante et persuadée que vous êtes aimée vous serez encore plus exposée à la risée de tout le monde, et particulièrement de celui qui n'a jamais été et ne sera jamais

'Votre ser'ture,

'M. N.'

"We must not omit to mention Chronograms. These are verses which contain within them the date of the composition. So at Graz, on the mausoleum of the Emperor Ferdinand, is the following :

'ferDInanDVs seCVnDVs le VIXit pIe obIIIt,'

that is, 1637.

"A very curious one was written by Charles de Bovelle: we adapt and explain it:

The heads of a mouse and five cats.....	M.CCCCC
Add also the tail of a bull.....	L
Item, the four legs of a rat.....	III
And you have my date in full.....	M.CCCCCLIII
	(1554.)

"It is now high time that we show the readers how to find the clue to a cipher. And as illustration is always better than precept,

we shall exemplify from our own experience. With permission, too, we shall drop the plural for the singular.

“Well! My friend Matthew Fletcher came into a property some years ago, bequeathed to him by a great-uncle. The old gentleman had been notorious for his parsimonious habits, and he was known through the country by the nickname of Miser Tom. Of course every one believed that he was vastly rich, and that Mat. Fletcher would come in for a mint of money. But, somehow, my friend did not find the stores of coin on which he had calculated hidden in worsted stockings or cracked pots, and the savings of the old man which he did light upon consisted of but trifling sums. Fletcher became firmly persuaded that the money was hidden *somewhere*; where he could not tell, and he often came to consult me on the best expedient for discovering it. It is all through my intervention that he did not pull down the whole house about his ears, tear up every floor, and root up every flower or tree throughout the garden in his search after the precious hoard. One day he burst into my room with radiant face.

“‘My dear fellow!’ he gasped forth, ‘I have found it.’

“‘Found what?—the treasure?’

“‘All but—I want your help now,’ and he flung a discolored slip of paper upon my table.

“I took it up, and saw that it was covered with writing in cipher.

“‘I routed it out of a secret drawer in Uncle Tom’s bureau!’ he explained; ‘I have no doubt of its purport. It indicates the spot where all his savings are secreted.’

“‘You have not deciphered it yet, have you?’

“‘No. I want your help; I can make neither heads nor tails of the scrawl, though I sat up all night studying it.’

“‘Come along,’ said I, ‘I wish you joy of your treasure. I’ll read the cipher if you give me time.’ So we sat down together at my desk with the slip of paper before us. Here is the inscription:

$$\begin{array}{c}
 \text{D} \qquad \qquad \qquad \text{A} \\
 + ^{A282\frac{2}{3}}9\beta9\beta2^A\chi879 + )789(9(88\overline{7\div})8-2\frac{2}{3} + 9 \times \frac{2}{3}2\frac{2}{3}-29\frac{2}{3}-)^{*}8228\chi- \\
 7\lambda082\lambda^*9\chi79 + \\
 \text{B} \\
 \times \frac{2}{3}7-\beta^*\gamma\chi9-\overline{7\beta-\chi8})\lambda48\overline{7\frac{2}{3}8}-=8\chi2\frac{2}{3}8\chi82\frac{2}{3}-+\frac{2}{3}8\chi8\odot\frac{2}{3}8\chi^*2\frac{2}{3}828\chi \\
 7\beta\lambda(2\frac{2}{3}8+8\chi\lambda=\lambda\overline{79\beta}\overline{7\lambda}7=-+\div-\chi881\lambda\chi^*92-+2.
 \end{array}$$

“‘Now,’ said I, ‘the order of precedence among the letters, according to the frequency of their occurrence, is this: e a o i t d h n r s u y c f g l m w b k p q x z. This, however, is their order according to the number of words begun by each respectively: s e p a d i f b l b t, etc. The most frequent compounds are th, ng, ee, ll, mm, tt, dd, nn.”

[The following letters occur in about the following numerical proportion: For every two of the letter q there are four of the letter x, eight of k, sixteen of b, thirty of c, eighty each of i, n, o, and s, eighty-five of a, ninety of t, and one hundred and twenty of the letter e.]

“‘Pray, Matthew, do you see any one sign repeated oftener than the others in this cryptograph?’

“‘Yes, 8; it is repeated twenty-three times,’ said Fletcher, after a pause.

“‘Then you may be perfectly satisfied that it stands for e, which is used far oftener than any other letter in English. Next, look along the lines and see what letters most frequently accompany it.’

“‘2 § undoubtedly; it follows 8 in several places and precedes it in others. In the second line we have 2 § 8—8 2 §—2 § 8; and in the third, 2 § 8 again.’

“‘Then we may fairly assume that 2 § 8 stands for *the*.’

“‘*The*, to be sure,’ burst forth Fletcher. ‘Now the next word will be money. No! it can’t be, the e will not suit; perhaps it is treasure, gold, hoard, store.’

“‘Wait a little bit,’ I interposed. ‘Now look what letters are doubled.’

“‘88 and 22,’ said my friend Mat.

“‘And please observe,’ I continued, ‘that where I draw a line and write A you have e, then double t, then e again. Probably this is the middle of a word, and as we have already supposed 2 to stand for t, we have —ette—, a very likely combination. We may be sure of the t now. Near the end of the second line there is a remarkable passage, in which the three letters we know recur continually. Let us write it out, leaving blanks for the letters we do not know, and placing the ascertained letters instead of their symbols. Then it stands—eχtheχeth—heχ<sup>h</sup>heχ<sup>h</sup>ethe—. Now, here I have a χ repeated four times, and from its position it must be a consonant. I will put



in its place one consonant after another. You see *r* is the only one which turns the letters into words—*erthe r th here . here the*. Surely some of these should stand out distinctly separated—*er there th—here . here the*. Look! I can see at once what letters are wanting; *th—* between there and here must be *than*, and then *. here* is—must be—*where*. So now I have found these letters,

$$8=e, r=t, \S=h, \chi=r, -=a, +=n, \odot=w,$$

and I can confirm the  $\chi$  as *r* by taking the portion marked  $\Lambda$ —*etter*. Here we get an end of an adjective in the comparative degree; I think it must be *better*.

“Let us next take a group of ciphers higher up; I will pencil over it D. I take this group because it contains some of the letters which we have settled—*eathn*. *Eath* must be the end of a word, for none begin with *athn*, *thin*, or *hn*. Now what letter will suit *eath*? Probably *h*, probably *d*’

“‘Yes,’ exclaimed Fletcher, ‘*Death*, to be sure. I can guess it all: *Death* is approaching, and I feel that a solemn duty devolves upon me, that of acquainting Matthew Fletcher, my heir, with the spot where I have hidden my savings. Go on, go on.’

“‘All in good time, my friend,’ I laughed. ‘You observe we can confirm our guess as to the sign  $\gamma$  being used for *d*, by comparing the passage—20 $\frac{3}{4}$ —)\*223X, which we now read, *t. had better*. But *t. had better* is awkward; you cannot make 9 into *o*; ‘to had,’ would be no sense.’

“‘Of course not,’ burst forth Fletcher. ‘Don’t you see it all? *I had better* let my excellent nephew know where I have deposited—’

“‘Wait a bit,’ interrupted I; ‘you are right I believe. *I* is the signification of 9. Let us begin the whole cryptograph now; *N.tethi.i.t.re.ind.e.*’

“‘Remind me!’ cried Fletcher.

“‘You have it again,’ said I. ‘Now we obtain an additional letter beside *m*, for *t. remind me* is certainly *to remind me*. We must begin again: *Note thi. i. to remind me.*’

“‘*This is*,’ called out my excited friend, whose eyes were sparkling with delight and expectation.

“‘Go on; you are a trump!’

“‘These, then, are our additional letters:  $\gamma=d$ ,  $\tau=m$ ,  $\beta=s$ ,  $\varnothing=i$ ,  $\lambda=o$ . To remind me *i.i.e.e.m.death*, *m. h.* for *m. death*, I read my

death, and *i. i. ee*, I guess to be, if I feel. So it stands thus: 'Note—This is to remind me, if I feel my death nigh, that I had better—'

"I worked on now in silence; Fletcher, leaning his chin on his hand, sat opposite, staring into my face with breathless anxiety. Presently I exclaimed—

"'Halves, Mat! I think you said halves!'

"'I—I—I—I—my dear fellow, I—'

"'A very excellent man was your uncle; a most exemplary—'

"'All right, I know that,' said Fletcher, cutting me short. 'Do read the paper; I have a spade and pick on my library-table all ready for work the moment I know where to begin.'

"'But, really, he was a man in a thousand, a man of such discretion, such foresight, so much—'

"Down came Fletcher's hand on the desk.

"'Do go on!' he cried; and I could see that he was swearing internally; he would have sworn *ore rotundo*, only that it would have been uncivil and decidedly improper.

"'Very well; you are prepared to hear all?'

"'All! by Jove! by jingo! prepared for everything.'

"'This is what I read,' said I, taking up my own transcript:

"'Note.—*This is to remind me, if I feel my death nigh, that I had better move to Birmingham, as burials are done cheaper there than here, where the terms of the Necropolis Company are exorbitant.*'

"Fletcher bounded from his seat. 'The old skinflint! miser! screw!'

"'A very estimable and thrifty man, your great-uncle.'

"'Confounded old stingy —,' and he slammed the door upon himself and the substantive which designated his uncle.

"And now the very best advice we can give to our readers is to set to work at once on the simple cipher given near the commencement of this paper, and to find it out."

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## FLYING OR FIELD TELEGRAPHS.

The duties of the Signal Corps, organized during the war of the Rebellion, extended to the management of field telegraphs, and light lines when the formation of the country

was such that aerial signals could not be used, or it was for any reason desirable that short electric lines be extended.

It is a duty of signal-officers to make themselves and their parties acquainted with all the modes of telegraphic communication. The transmission of signals by electricity, and the transmission of visual signals, are to them equally the subjects of study, and they should be prepared to judge where either is practicable or preferable.

As the army occupies a new country, they should be able, by reconnoissance and the study of maps, to determine where electric lines ought to run, and where should be the stations for aerial telegraphs. They should know how to prepare and to command the proper details for the construction of temporary lines, and to guard, inspect, and repair them. They should be able to assign these details with instructions so clear as to insure the proper performance of the duties. They should understand how to dispose troops for the protection of stations, and be familiar with the precautions necessary to prevent surprise.

Signals can be transmitted by the signs or sounds caused by electricity, following the plans of any of the signal codes heretofore illustrated.

Officers and men thoroughly practised in the codes of aerial signals will find little difficulty in applying their knowledge to transmitting or receiving signals by electric wires in codes of whatever numbers of elements.

Electric instruments may be of the most simple construction. Electric lines can be set up, and be very useful in hundreds of places where they are now, if thought of, deemed impracticable; and they can be worked without other skilled labor than that of the soldiers attached to the posts, and with no apparatus but such as can be had at a trivial expense.

There is no reason why, with properly drilled parties, electric lines may not be thrown out in the moments which precede or even during the progress of a battle, and be so worked as to lessen infinitely that difficulty of rapid communication, which has so often caused disaster.

Portable lines, and parties drilled to serve with them, should accompany an army, as does its artillery, to be used successfully for one day or one battle only, if that case needs be, provided they may, by successful use on that day or at that battle, contribute to a victory.

With a corps well organized and well equipped, the connection between the corps of an army and between the corps-headquarters and general headquarters, ought to be perfected in a very few hours after the halt of the army.

It was claimed for the Signal Corps during the war, that it, at the battle of Fredericksburg, brought into operation, for the first time in the service of the United States, a telegraphic station working upon the field of actual battle, and exposed to the same fire as the general and his staff.

Electric lines and stations ought, if properly served, be often thus established and held under fire, and with circumstances of great hardship and danger.

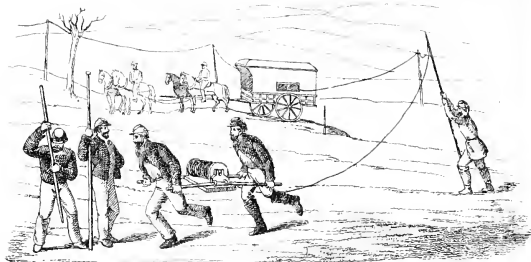
Officers and men who share the danger of other soldiers ought to have the same incentives, the protection, and the usefulness secured to them by military position and discipline.

The Field Lines of the Signal Corps consist of rolls of wire carried in light-wheeled vehicles, and light "lance poles" as they were called, on which the wire is stretched when necessary. The wire, made for the purpose, is of small strands of iron and copper twisted, to give it strength and flexibility. It is insulated with prepared india-rubber, or other material, and wound on reels, which, in an emergency, can be carried anywhere by hand, while the wire reeling out can be raised upon fences, fastened to trees, or



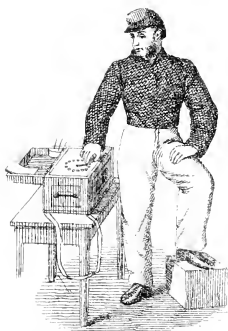
# PLATE XXVIII.

Fig. 1.



The Signal Corps Telegraph - Setting up the wire.

Fig. 2.



The Signal Telegraph. The Operator at Work.

Fig. 3.



Signal Station at Night.

laid along the ground. (Plate XXVIII, Fig. 1.) The instruments used at first were of a kind known as the Beardslee Instrument.

These instruments are worked without batteries, the electric current being generated by revolving magnets. They were "indicating," an index upon a dial pointing, at the receiving station, to whatever letter was designated by the index handle upon a similar dial at the sending station. (Plate XXVIII, Fig. 2.)

There were as advantages attaching to this instrument, that it was portable and compact, could be set at work anywhere, required no batteries, acids, or fluids; and, what was thought of importance in the early days of the late war, and while the corps was a temporary organization, it could be worked by soldiers without skill as operators. The defects were, that messages could not be sent as rapidly or as far as by some other instruments. Nor could several instruments work easily upon a single circuit. For some uses on the field of battle, or under fire, where the attention of the reader is disturbed, it is, perhaps, as good an instrument as has been devised. With a permanent corps, or at secure stations; it gives place to some of the forms of signal or of sound instruments.

The instruments upon field-lines may be of very simple structure. The signal instruments, either the needle or the letter instruments, can be used in actual conflict, if the reports of heavy guns or other disturbances of action render reading by sound unreliable. The manufacture of both instruments and batteries has been improved, until there is now no trouble in carrying either in the field in the roughest campaigns.

The difficulty in reading from telegraphic instruments by sound, which has been the greatest obstacle to their use, can be almost done away with by using them with codes of easy signals.

Almost any one who can commit to memory a code of signals can, with a few days' practice, read from a telegraphic instrument, if it makes two or three distinct sounds only; and these alone are used to form the alphabet. A good signalist can read slowly without any prior practice, if he causes to be sounded by the instruments any code to which he is accustomed. The sound-alphabet in general use among telegraphers is greatly and unnecessarily complicated.

Standard works on Electric Telegraphy so fully describe the different styles of apparatus already in use, that no especial description need here be given.

Every command can have within itself the men and material for establishing its own stations. There is no difficult art to be acquired. Instruments which can be carried in the pocket, with batteries easily transportable in a knapsack, are sufficient for short lines. A pack-animal with panniers can carry, anywhere that troops will march, material and supplies for more extended operations.

Plate XXIX. is intended to exemplify the manner in which the Field Lines of the Signal Corps can be used to perfect the service of the corps, and to illustrate circumstances which often occur, and in which their use is absolutely necessary to make the corps service efficient. The electric stations at A and B enable reports of observation to be taken immediately to headquarters at camp from the points C, and D, and E, and F, which are otherwise shut off by the forest. And these stations can be established and worked for less than the cost of the horse required to mount a single courier to ride from them.

Plate XXX illustrates the communications between the land and naval forces at the commencement of operations against Mobile, and given after Admiral Farragut had passed the forts with the fleet.

For a line to use a vibrating needle, there is needed only



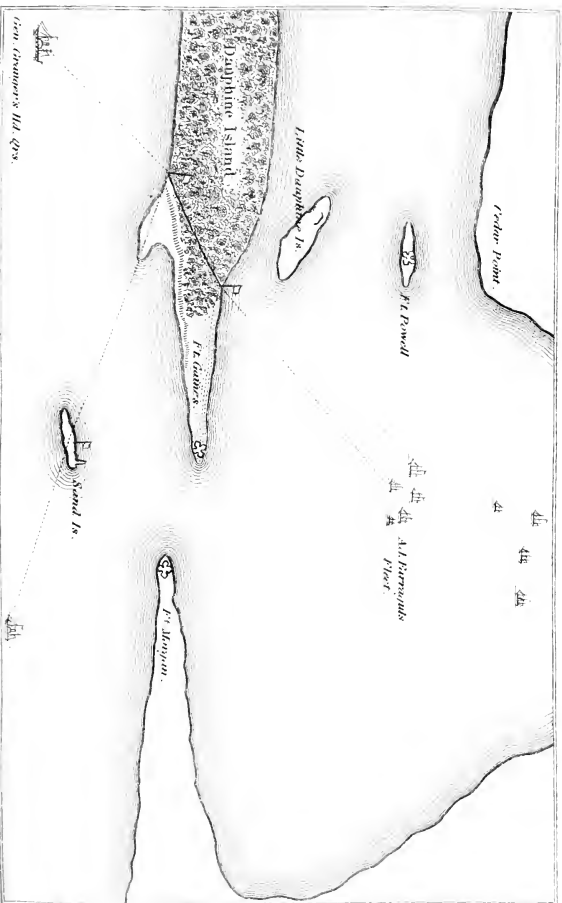
# PLATE XXIX.



Field Telegraph Line & Communicating Signal Stations.



# PLATE XXX.





a magnet and a wire. The apparatus for working by sound is not complicated.

Field Telegraph Trains ought to be always furnished with wire of two kinds: insulated for sudden emergencies, when the line must be thrown out without delay, and may lie upon the ground, or may run through streams; and a light copper or other wire, to be used with more permanent lines.

Lines put up for temporary use with insulated wire should be relieved, if likely to be permanent, with other wire. The insulating material becomes frayed by friction on trees or poles. The insulated wire removed should be carefully repaired, tested, reeled, and held for future use. A twisted copper wire is, perhaps, as flexible and as useful as any for service in which the same wire is to be often used at different places. A supply of insulators of such size, that a large number of them may be carried in a pouch or haversack, and made to be screwed or driven into trees, posts, etc., should be carried. Temporary insulators have been made with bottle necks. Wire, both plain and insulated, must always be in reserve, so that in the moment of battle reliance need not be upon damaged material. The supply-trains must carry material to at once replace a damaged or disabled line. Each field-train is accompanied by men practised to serve with it.

A supply-train carries extra material.

With a marching army, the flying-trains as they are called, those which carry lines for instant service, are moved habitually well to the front with the moving column, precedence being given them as to the artillery. The wagons are light, and are not troublesome. When the movements of a battle commence the roads are thronged, and trains cannot be then brought quickly forward.

While the army marches, lines are thrown out to particular points, and such only as are designated in especial orders. When the army halts, each corps detachment

makes its connection with general headquarters as quickly as possible.

When the army remains for a time in the front of an enemy, light branch lines are pushed out to the front, to wherever information can be concentrated for headquarters, and where they may receive the reports of reconnoitring officers, secret stations of observation, and signal-stations established still nearer the enemy's lines.

In the co-operation of Land and Naval Forces, a signal-station established upon the shore, can keep communication with the fleet while light lines reach the army hidden from view inland.

At sieges, the light lines go to the front, wherever they are needed. They can follow the trenches as fast as they are opened. The insulated wire ought to be laid on the bottom of the trench, and held close to the rear slope by wooden pegs driven into the earth. By this plan the wire is protected from the enemy's fire, and is not in the way of the troops in the trenches. An exposed wire is often cut by the fragments of shell, and sometimes purposely by the enemy's sharpshooters.

On the eve of a battle the chief signal-officer ought to be notified, and should have information of the number of miles of line that may be needed. He learns from the chief of staff the plans of the lines for the engagement, as nearly as may be. The probable position of the general-in-chief is ascertained. The chief signal-officers of corps detachments are then instructed, and each of them arranges that his field-lines may run to general headquarters-station as soon as the corps to which he is attached takes its position. The station near the general-in-chief is the headquarters-station; the stations near corps commanders are field-stations.

As the corps take their positions, the chief signal-officer sees that the headquarters-station and the field-stations are established. The points to which the general wishes com-

munication are reached in the order of their importance. The flying lines must be carried out by incessant labor, no matter with what difficulties or what fatigue. There should be no rest until the lines are run out, the patrols placed upon them, and communication assured by messages exchanged between the generals. A line working in time may save an hour of delay to the army. History is crowded with examples where the use of flying lines might have assured victory.

The light electric lines ought to be carried always well off the main roads, and through the fields or woods, to avoid the march of troops. When thrown out before a battle, they should be run, if possible, over such parts of the ground as will not be traversed by artillery or cavalry. They must be stretched over thoroughfares on high poles or lances. It is advisable to carry the lines from headquarters-station laterally, and well to the rear of the place of actual battle, and to then run the wires toward the field-stations in that direction which will be coincident with the line of march of the troops, instead of crossing that line. There will be thus less danger of damage from the necessary movements of the army.

A detail for patrol duty must be made before the action; and patrols, stationed a few hundred yards apart, will keep every part of the wire in view during the battle. These patrols should be instructed how to splice the wire if it is broken, and be furnished with little clamps or screws to temporarily join it. The lines are to be assigned by sections of length—as of half a mile or a mile—and a sergeant or artisan of the Signal Corps ought to be detailed for each section, whose duty it is to pass continually up and down his section, to review the splices made by the patrols, and to see that the line is kept perfect in all its parts.

The men should lie upon the ground when mending wire under fire.

A commissioned officer should be on the field with each corps detachment, and in charge of the field-lines of that corps. Two sergeants are to be stationed at each instrument. A signal-flag bearing a cross must be kept flying at each station, as a guide to those bringing messages. A number of mounted couriers should be assigned for each station. All the appliances for work must be carefully provided. Spades, pickaxes, and implements must be at hand. Lanterns must be ready for night-work. There must be a proper supply of blanks, note-books, etc. A line may be disabled by some little neglect in such provision. Field-stations must be near the corps commanders, or where they can easily reach them. If the fire is heavy, the stations ought to be located in ravines or in some depression, keeping a crest higher than the instruments between the station and the enemy. They may be placed behind cover of any kind; a trench may be made for this purpose.

The officer in charge of each station must ascertain where the general with whom he serves, or some one to represent him, will be found to receive messages; and generals should provide that instructions on this point are carefully given, and that members of their staffs know the positions of the different stations. Much valuable time is sometimes lost in the wandering search of the orderlies, bearing messages from the instruments, for those for whom they are intended.

Officers sending messages before or during an action should make them brief, intelligible, and write them plainly. A copy of each message sent ought to be kept at the instruments. If the message is of great importance, and the persons bearing it have to go under fire to reach the instruments, separate copies ought to be sent by separate messengers.

If a field-station is threatened by the enemy, the officer in charge ought to be personally at the instrument, and



must see that the line is not abandoned until it is absolutely necessary; and that the instrument is carried off by the men on duty. The instrument should never fall into the hands of the enemy. If it must be abandoned, let it be destroyed, and with it all messages and every article that could in any way aid the enemy.

If a station is to fall back, and there is time, the wire can be coiled on the arms of the men after the manner of a rope coil, and thus be saved. The officer in charge should, on reaching a place of safety, at once procure from the reserve supplies new wire, lances, etc.; and be ready, watching his opportunity, to reoccupy his station the moment the position of friendly forces renders it again tenable.

If he has fallen back along his own line of wire, he may open communication with headquarters-station from a position more to the rear. He must at once report his new position to the corps commander, and he must keep his flag displayed there as a guide to those seeking the station.

If a station is to advance with the advance of the forces, the officer in charge must see in time that he has wire and material, and a party at hand to keep pace with the movement. He must at once give notice of his new position as soon as he has opened communication with general headquarters from a station in advance.

Whenever the movements of the army permit any line to be abandoned, it must be immediately reeled, repacked, and reported to the chief signal-officer, that it may be held ready to be extended in any other location.

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There have been here given outlines of such instructions as were formed for the signal-officers serving with field-lines during the war. They have reference to those lines only which ought to be in the hands of corps organized

especially for service in the field, and for services of this nature.

Where lines are permanent for months, as behind an army, or running through a guarded country, the service on these, as on civil lines, may be by citizen *employés* of the quarter-master's department.

When signal corps are organized, they ought, wherever in actual service, to have control of light telegraphic lines, to be either worked by the corps, or, if for any reason, by citizen *employés*, these to be subject to the orders of the chief signal-officer; and the officers and men of the corps should be drilled in the service and working of their lines with as much precision and regularity as artillery are taught at their guns. The Military Board convened in 1863, to report the organization and duties of the Signal Corps, approved in strong terms this part of the equipment.

The officer or enlisted man who can skilfully read signals addressed to the eye, will, with a few days' practice, read as well those made, whatever may be their style, with telegraphic instruments. An officer charged with the duty of opening communication over lines by aerial telegraph signals should be able to complete such lines through woods, or where obstacles intervene, by electric signals, to be transmitted, as are the aerial, by his own men and under his direction. Considerations of economy also necessitate this. The sergeants and privates of the signal corps, men of full age, many of them good scholars, and each selected after examination, can as well attend the simpler telegraphic instruments as can the young clerks now employed for that duty, and do so at a rate of pay amounting to about one-third the sums now demanded by inferior operators. An intelligent sergeant can read the sounding of the Beardslee instrument with a fortnight's practice. A code of *two ele-*

*ments* can be read by sound from a Morse instrument with a month's practice. The more complicated alphabet now everywhere used on that instrument, and to read which well requires from three months to a year of practice, is not suitable for a *sound alphabet*, was never intended to be read by the ear, and is continued in use because the first operators learned to read by it, and those of a later day have followed their practice without inquiry. It was devised as an alphabet for record or writing. In time of peace, this duty of telegraphing might remain to the corps in so far that the chief signal-officer at any post might have supervision of the terminus of the main electric line there; and when an expedition moved into the field, the signal-officer should be expected to provide all arrangements for its telegraphing, and be responsible for the execution of that duty.

A few reels of wire at each frontier post, some simple instruments and appliances, can be furnished at an expense which, as compared to their usefulness, is trivial. A sergeant and half a dozen soldiers, taught as operators and line-men, are a sufficient establishment.

When there is not the need of telegraphic service, these soldiers, armed, are as valuable as any others; or taking the field with signal equipments and glasses, they offer everywhere to the commander a power which, a few years ago, was not imagined, and which every educated officer must now appreciate.

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## GENERAL SERVICE OF THE SIGNAL CORPS.

The general service of the Signal Corps should be so conducted that the corps may offer a body of educated and skilful officers, practised in the duties of reconnoissance, the studies that pertain to them, and the habit of making con-

densed reports; skilled also in the arts of cryptography, in ciphers, and in the especial branches of semiology and telegraphy: the soldiers of the corps, disciplined and drilled in the use of their arms; and, as soldiers, should be besides so drilled in the practice of signalling that each may be able to transmit any simple message in a common code, and so to report intelligence gained by him, or to send communications confided to him for that purpose. The practice in signalling should be habitual, as is that in the Manual of Arms.

When field telegraphic lines are to be used, selected details must be practised with them until they are skilled in the management of the instruments and the lines.

The useful service of the Signal Corps is by no means limited to those brief periods during which an army is in actual movement against the enemy. When the army is at rest and time hangs heavily for want of active service, the signal-officer can never act amiss if his parties are kept in motion, scouting systematically in the direction in which the enemy are; gathering knowledge of their position and intentions, exploring and roughly mapping the country, with its roads, trails, springs, water-courses, etc., noting its facilities for the supply or the transit of troops, etc., and so collecting, day by day, while there is time, information of every character, the value of which in reference to his future movements the commanding general will not fail to appreciate. In an Indian country, large tracts can be thus swept over, the dominant points noticed for convenience in future operations, in which the use of signals may be necessary, and telescopic observations made from peaks and places to which no other corps in service is called by duty. From a single elevated peak, the general make of the country, its grazing-grounds, valleys, water-courses, forests, etc., can often be marked with an exactness which would require days of painful marching and the movement of large forces to secure by

following the roads. From separate communicating peaks an extent of country can be kept in such observation by a small detachment, that the main body need rarely move, unless upon definite information. A few signal-stations near a camp or post afford a better guaranty for its safety, or that of herds, trains, etc., near it, from unexpected attack, than can be otherwise had. In many parts of the country west of the Mississippi, a line of stations connecting commands or posts would be at once points of observation, save all need of couriers, and enable movements to be made from one command to intercept marauding parties, pursued or traced from the vicinity of the other, with a rapidity to insure their capture. A reconnoissance for signal-stations in which the proper dominant points of a district are to be visited, and the country thence viewed and mapped, will add much to the topographical knowledge of the country; and for such general knowledge as is needed for military operations, is better than an ordinary survey. These, and a hundred other employments of a signal-party, will suggest themselves to intelligent officers acting in an Indian country. The skill of the Indian lookouts can be neutralized. Our plans of signalling, our telescopes and apparatus for observation, are as superior to their efforts as we are in our civilization superior to their barbarism. It is not probable that any commander who has enjoyed in the presence of the enemy the facility of communication the Signal Corps has given, will willingly find himself in active operations without a representation of that corps.

It has been attempted to show on preceding pages how details from the corps can be made useful wherever telegraphic facilities of any kind are needed.

In such labors, the study they will necessitate, the preparation of books, papers, and forms for systematizing and fixing their duties, will, perhaps, be found the employment of a signal-corps for a few years to come. The field is suffi-

ciently extensive, and the work is necessary. It is not probable that within the coming century any well-appointed army will take the field without a signal-corps of some kind, or that the co-operation of land and naval forces will be attempted without a service of this description.

The condemnation sure to fall upon any commander who should invite disaster by the neglect of means so often and successfully tested, will insure their employment.

For service with a grand army, consisting of several corps, and in the field, the following organization was recommended by the Military Board of 1863 :

*Basis, an Army of Two or More Corps.*

At General Headquarters, Staff of General commanding :

- (1) One Captain, Chief Signal Officer of that army.
- (1) One Lieutenant, Adjutant, Officer in charge of Records.
- (1) One Lieutenant, Quartermaster, Ordnance Officer, and Property Officer commanding Depot Camp.
- (3) Three Sergeants, as Clerks.
- (6) Six 1st class Privates, as assistant clerks, flagmen and escorts.
- (2) Two Sergeants in charge of Reserve Camp, Depot, Stores.
- (4) Four 1st class Privates in care of stores, repairs, etc.  
2d class Privates detailed, three from each Corps Party, as guard of Reserve Camp, etc., and in charge of Depot trains upon the march.

Depot Camp to be near Headquarters.

Such other details as may be necessary for the service at General Headquarters to be made for the occasion.

*For each Army Corps.*

- (1) One Captain, Chief Signal Officer of the Corps.

- (1) One Sergeant as Clerk.
- (1) One Sergeant as Quartermaster and Commissary Sergeant of the Corps Party and in charge of Train.
- (8) Eight Lieutenants.
- (5) Five Sergeants.
- (20) Twenty 1st class Privates.
- (34) Thirty-four 2d class Privates.

Additional details for special duties, or when strong guards or escorts are to be required, to be furnished at the discretion of the general commanding the corps.

The number of lieutenants was estimated to provide for corps of three or four full divisions. The officers to form reserve parties to be detailed from the corps parties as occasion required.

The Board suggested the following detail for each Field Telegraphic Train:

"The following detail is suggested for each Field Telegraph Train. The detail to be drawn from the Army Corps detail:

- "(1) One Lieutenant, in charge of Train, commanding.
- "(1) One Lieutenant, as assistant, when necessary in case of extension of lines required to be worked by commissioned officers, or on the field of battle.
- "(2) Two Sergeants as chief operators, etc.
- "(8) Eight 1st class Privates as operators and line-men.
- "(12) Twelve 2d class Privates.

"This force to be increased by details made by the commanding general at his discretion, or by the chief signal-officer of the corps.

"The 2d class privates to be, when not on actual duty on the line, for detail on escort and general duty."

This detail was for trains intended to be used on the field of battle.

The organizations estimated for time of war and for large armies in active service must be greatly reduced, both as to the number and the grades of its members in time of peace.

Signal-parties should be armed as cavalry, with revolvers and repeating carbines. In camp, or where large numbers are serving together, the organization and provision should be that for companies or battalions—sergeants acting in place of corporals. Parties taking the field for service constitute detachments, certain men being detailed for duty with each officer. The organization of engineer troops affords an example.

When serving for a length of time by detachments on different stations, each officer returns for his own men, and is responsible to the chief with the forces for their duty and equipments.

The chief signal-officer in a military division or department consolidates at headquarters the rolls and returns of officers and men, and is responsible for their proper supply and instruction, as other chiefs are responsible for staff corps.

Reference to the instructions which have preceded will, it is hoped, convince the reader that it is within the power of any commander, who may so will, to be himself a signalist, and to have attached to his command officers, and men, instructed by himself if need be, whose aid in some emergency may save not only himself and his command, but a decisive action. The saving to the national cause of Sherman's base at Allatoona in the campaign upon Atlanta, the skilfully directed fire of Porter's squadron on Fort Fisher, and numerous instances which might be cited, will recall the value of a few simple messages signalled at the proper moment.

At the beginning of the war, the use of army-signals was almost unknown. Telegraphs were novel in armies, not



practically well understood by our soldiers, and not provided for in organization. Very little was known of the principles of telegraphic communication. It was not known how simply signals could be made, nor at what great distances they were legible. The duty was experimental. During the war of the Rebellion the services of the Signal Corps were greatly developed, and at its close the records show their admitted value.

As the officers who command our armies and our fleets become yet better acquainted with the uses of signals and telegraphs, the facilities they give in operations, and the ease with which they may be employed, thousands of applications will be found which are not now thought of.

Each chief signal-officer should cause the subjects of his duties, and their value, to be comprehended by the general officers with whom he is serving; and each chief should see that every post in his department, which might be liable to be at any time isolated, is furnished with equipments, codes, and instructions to use them. The issue of these notes will render this practicable. Similar provisions ought to be made for co-operating naval vessels, and the chief of each department acting under instructions from the central office, should be held responsible that no detriment happens to the service from any want of communication between its different branches.

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A signal-officer cannot be too well educated, nor too good a soldier.

The perfect organization and discipline of the signal-parties require some knowledge of organization; of military rules; the manual of arms; and of tactics.

In providing for his own safety on lonely stations, or the safety of lines under his care; in his marches with small

escorts; his reconnoissances; and in the drawing of the papers in which finally are summed the results of his labors, he will find ample exercise for all soldierly knowledge he can gain.

There is no branch of the service in which military practice and scientific attainment may add more to the value of an officer, or be more variously employed to advance the interest of the State.

The duties of signal-officers in time of war, are to gain as reconnoitring officers all knowledge of the country, of the movements of the enemy, and the position of our own forces, which, communicated to the commander, may aid in forming his plans; to collate from all sources whatever information may be of value; to secure the quickest transmission of intelligence within the lines of the army, and to connect the divisions of any forces by the most rapid communication.

As cavalry has been styled the eyes and ears of an army, so the detachments of the Signal Corps, properly equipped and handled, and serving with efficient escorts, should aim to make themselves the army's eyes and ears and tongue. In the presence of the enemy, selected officers of the corps secure information by observation and by reconnoissance or scouting. Their service is then that of a corps of well-educated guides, and they are aided in the transmission of the intelligence they may gain by the modes now used in our army; others maintain the lines of communication over which the reports are to be passed, or which connect the else separated forces.

The chief signal-officer with an army ought to stand in the relation of almost a confidential secretary to the general commanding. Through him should go dispatches, communications in cipher, etc., and he should be held responsible for their transmission, delivery, and record; and by him should be collected the detached reports and communica-

tions which, coming in as brief dispatches from different sources during the day, admit of collation and consolidation, to give some connected information at night. His office is a bureau in which to concentrate, and whence to distribute, reports of general information in reference to any section of country, or any particular military operation. The general supervision of courier lines may be confided to this officer in connection with the duties of his corps, and special scouts report to him for particular assignments.

Preparatory to an action, the Signal Corps should be divided into three parties:

1st. A reconnoitring party.

2d. A party for service on stations.

3d. A party to serve with the flying telegraph.

The officers of the reconnoitring party, moving out before the action and during its continuance, penetrate everywhere, by different roads, upon the flank or towards the enemy, and, gaining whatever knowledge they can, report to the stations, which in their turn concentrate this knowledge at headquarters.

These parties do not rest during the engagement, and each of them sends frequent reports by courier. They carry with them, on some of the roads, bombs or other signals, and establish posts which may warn if the enemy attempt certain anticipated movements. They are continually on the alert, and are furnished with definite instructions as to the facts concerning which they are to observe and report.

The station-party occupies points upon or near the field, whence they can view the enemy's position and the circumjacent country, and report continually, during the progress of the action, to the headquarters-station and to the telegraphic stations, whatever comes under their observation.

The telegraphic party carries the light telegraphic lines to the different corps-headquarters as soon as the troops are

established, and also through such woods or other obstacles as would else prevent communication from the dominant signal-stations; and upon or near these stations they establish telegraphic stations to communicate by signal with others inaccessible, or to change frequently.

If naval co-operation is expected, officers are detailed to report to the senior naval officer before the action, and are assigned by him to different vessels. These officers ascertain as nearly as may be the proposed positions of the fleet, and prearrange with those on shore the points at which they will be in communication.

If communication is to be between ships in a bay or river, the officers will consult together, if possible, before parting, as to the place at which the ships will probably be, the color of the flags it will be best to use, and in what direction, by compass, the vessels will be from each other. They will consider, also, whether signals will be preferably made from the decks or the rigging, as the "tops," and whether the make of the land or river-bank is such that it is likely the hulls of the vessels will be hidden from each other, as by rising grounds or by trees. It is possible this will be the case. It will be considered, also, whether the masts will show above the trees, and how much of them will show. To ascertain this point, the officers should, together, ascend the rigging and estimate the height of the obstacles in the direction in which it is supposed the signalling will be necessary.

When any part of the mast of a vessel can be seen above the trees from the top of the mast-head on any other vessel, communication can be had from "Crow-nests," fitted at the mast-heads of the corresponding vessels.

When vessels, co-operating with land forces, are to go into action, the post of the signal-officer is the "foretop," or in the "maintop," and arrangements must be made for raising or lowering written messages by cords. A signal-flag

should always be kept flying from some prominent position on every vessel carrying a signal-officer. Signal-officers, serving with troops, or on other vessels, can thus know with what ships it is possible to have verbal communication.

Signal-officers carrying with them apparatus for day and night signals, and always some rockets and candle-bombs, should invariably accompany forces about to land. A few preconcerted signals for possible events should be arranged before landing; and the landing-signalist and the signalist to remain on ship-board should together determine some points on shore from which the first communication shall be had. Forces landing and moving inland, so as to be covered by woods, etc., may yet indicate their progress and preconcerted messages by Chronosemic Signals, as rockets and bombs thrown above the trees, and can receive the recognition or reply, by guns, or other sound-signals.

If there is a commanding peak near where the enemy offer battle, signal-officers should be hurried to it in advance of the army. The enemy are to be kept constantly in view from the time the position is reached. The knowledge to be gained by witnessing thus the formation of their forces, by estimating their strength before their lines are in position, and by witnessing early what preparations are made for the battle, may be invaluable.

In a reconnoissance of a field of battle, the signal-officer must notice carefully how many lines of battle there are, and he must not fail to report the number. If furnished with a scale-glass, he must find the distance and direction of almost every marked object in the enemy's line, from some known point within our own. Make this observation particularly in reference to batteries, reserves, ammunition trains, etc. Report these distances and directions with precision to the general commanding, and to the generals near you. Send copies also to officers commanding heavy batteries. Note carefully and report the direction in which

the enemy's guns are pointed, what roads or fields they seem to cover. See where their cavalry is posted, or where they have cavalry pickets out. This sometimes shows the position of their flank and of the point from which they fear attack. Study closely the ground in cornfields, in groves, in fields covered with low bushes, behind stone fences, for lines of men lying hidden in ambush, or for masked guns. Seek such forces, not only in front of the lines, but far to the right and left, over which the troops are to pass. They may be so posted to have an enfilading fire on the advancing lines. If artillery is to fire upon any point not visible from the guns, notice something near it by which to point it out; give the exact bearing and the distance of the object from the battery, and regulate the aim by signals from the station. Signal-officers should make themselves acquainted with the elevation, charges, length of fuse, etc., allowed in artillery firing at different ranges. Give the distance and direction of any thing described and to be sought within the enemy's lines from some marked point, as a house, a hill, or tree, also within the enemy's lines and visible from our own. If the enemy have covered, or are covering, any part of their line with breastworks or in trenches, the fact should be fully reported upon. If the enemy commences to change a line, notify the commanding general of the fact at once, and report, from time to time, the progress of the movement. Continue to watch and to report upon the enemy in their new position. Report the direction and extent of the new line so far as it is visible, and state to what point it probably extends, if it is hidden in part from view. Ascertain, as nearly as possible, the points at which troops are massed or massing, and estimate their numbers.

It will add much to the value of all reports if the reporting officer has a knowledge of the different orders of battle.

While observing the enemy, notice minutely by what roads and whence their ammunition and supply-trains come.

To be able thus to judge where their depot is located may be important. Examining villages, houses, or walls, near the field of battle, see if they are loop-holed. Notice bodies or small parties of troops moving into or out of them.

Lines of battle may be described by their number, length, position, and the direction in which they extend, given by compass. Trains are reported by their length, the number of wagons, or the time occupied in passing a given object: artillery, cavalry, and infantry, by the number of guns, the regiments, or time of passage at the ordinary rate of march.

#### CAVALRY RAIDS.

When a hostile cavalry force is reported in the vicinity of an army, or as moving through any section of the country, a signal-party should at once be sent to follow it as closely as they may, to report upon its movements, and to annoy it by indicating its position to such of our troops as may be in pursuit. These signal-parties fire, at different times at night, rockets or roman candles, to show the general direction in which the enemy may be. During the day cartridge-puffs or heavy smokes should be raised, for the same purpose. Codes of chronosemic signals may be used in cases of this kind with splendid effect. To this end of attracting attention and directing the march of friendly troops upon the enemy, if there is a known chance to capture or destroy them, hay-stacks, wood-piles, or out-buildings ought to be fired (using proper judgment), anywhere they may be found in the country lying near the line of the enemy's march,—the officer ordering the firing giving a certificate to the owners, that the property was fired for government uses. The firing of these signals, of any kind, must follow the track of the enemy from place to place. It is the object to thus mark his course, that preparations may be made in his advance to intercept him, or that

troops in pursuit may know in what direction to march or to concentrate. So in front of an enemy, presumed to be advancing on any roads, small signal-parties should be sent out on every road. These parties are to fall back, firing signals, raising smokes, or kindling fires, as the enemy advances. Some of the parties ought to conceal themselves near the roads, to gain all the information they can before reporting; others to wait, with the signals ready to be fired, and only light them when the foe drives them from their position. Thus a cartridge-puff may be raised at the last moment it is safe to remain at a station. A few daring men can thus cause infinite annoyance to an enemy, whose success is often depending on the secrecy of his movements. In all cases of this kind, a dominant station, or stations, must be chosen somewhere, from which the signals made, in any part of the country, can at once be noted and reported, and whence reports must frequently go to the senior commander in the vicinity, and to the general commanding. A constant watch must be kept from this position; and signals seen in any part of the country must be at once reported as to their distance, kind, and direction.

When several parties are in pursuit of Indians, that upon the trail may notify the others of its direction, etc., by chronosemic signals, fired from time to time, as above described in the pursuit of cavalry.

#### OBSERVATION AND RECONNOISSANCE.

The observations and reconnoissances made by signal-officers differ from those of other reconnoitring officers, in the facts that, by their long practice, they are able to use their telescopes with an almost wonderful skill; and that the information they gain can sometimes be compared by them, from the place of observation, with that had at the same



time by other officers in view and watching the enemy from other points, by the immediate transmission from one to the other of the facts noticed by each. The reports of their reconnoissances can also, in many instances, be at once communicated to the commanding general from the place at which the observations are making, while the reconnoitring officer remains to add further to his information. The reports are of a general character, relating to the presence or movements of the enemy, etc., such as are made by scouts. They are not expected to embrace the specialties exhibited in a report of engineers. An officer is often posted for weeks together at one station of observation.

For a principal station of observation, a point dominant to the surrounding country, within good range of the place to which the reports are to go, and within good range and view of other stations which are to communicate with it, should be selected.

The principal station of observation ought to command a view of fords, principal roads, railways, bridges, towns, camps, gaps in mountains, rivers, ports, as the case may be, and generally of the routes of march or movement in that section of the country.

When one permanent station of observation has been selected, other temporary stations ought to be chosen at points within a few miles, and the country covered by them should be studied in the same way as from the principal station. The officer in charge of the permanent station can then, at any time, send a subordinate or go himself to either of these stations, whenever especially extensive reconnoissances or reports are needed.

The observations from permanent stations should extend to points far from the enemy's lines, and to all the routes by which an enemy might move.

Observations should be made of the different parts of the country at different times each day, and any point to be

critically examined should be particularly scrutinized when the sunlight falls strongly upon it.

Stations near the enemy should always be carefully guarded by pickets and outposts; and if they are at all important, an especial guard should be provided.

An officer assigned to a station of observation should be always supplied with the best attainable map of the country; his glasses and signal equipments; a scale-glass, if possible; a time-piece, dispatch blanks, compass, pencils, papers, blue and red pencils for drawing on maps, and tracing-paper on which to extemporize maps.

A portion of every signal-party must be organized and well equipped with implements for the erection of towers and platforms, and the construction of stations generally.

An officer about to occupy any position should prearrange for the construction of a tower or platform in trees, as soon as he may reach it. He must select the exact ground himself, and must in person superintend the construction; especially if it is to be in the presence of the enemy, or if an engagement is expected. His party should carry with it axes, ropes, and nails, that no moment may be lost in securing a position for successful observation.

Observations of reconnoissance are generally made from several prominent stations. They are to be briefly made, but they ought to be made with scrupulous exactness. The parties moving with signal-officers on reconnoissance are generally small. They should move with the utmost rapidity and secrecy.

Near the enemy, advance guards or videttes of two or three men should be kept out, each about two hundred yards from the other. There should be, in the same way, one or two videttes in the rear of the party. In suspicious localities, a vidette or two ought to be sent out three or four hundred yards on each flank, and then keep up, going through the fields, woods, etc., with the movement of the

party. No matter how small the party, these precautions should be taken. If there are but two men accompanying the officer, one ought to ride well to the front just in view, the other at some distance in the rear. The officer should always keep himself thus guarded, riding near the centre of the party, where, if the party is strong enough, he has a little reserve. At each point at which he halts for observation, to use his glass, his compass, his maps, or flags, he must throw out his videttes and station them to watch all dangerous directions. These are instructed to raise a shout, or make some signal under any circumstances, if they are captured or if they are in danger of capture. It is the object of this care to make it impossible to surprise and capture the whole party. In case of danger, the party rallies and fights, or escapes.

On this duty, officers seek the points likely to command a view of the country in which the enemy are. They examine roads and map them roughly, being careful to give always a complete scale of distances and the compass points upon the map; and they mark upon this map, as well as they can, the positions in which the enemy are seen, or where they are said to be located.

Information as to the best points of view in any country, for the purpose of examining in any particular direction, can generally be had from citizens. Careful inquiry should be made on this point; and it should be remembered, while interrogating, that persons not accustomed to the telescope, cannot, understandingly, advise for the selection of points for its use, and that they have but little idea of the great distances at which it can be successfully employed. They should be questioned, therefore, when naming points of view, as to what towns, cities, rivers, roads, etc., are thence visible.

In making a reconnoissance, it is always well to be accompanied by an experienced countryman as a guide, and

such guide should be obtained, if possible, before the party starts out. When this is impracticable, such assistance must be sought from persons residing near points whence the observation is to be made.

It is a rule, in any case, when without special information, to seek the summit of the highest hills in reach. The party should carry axes, as the felling of a few trees or bushes will often make a station, otherwise of little value, the most useful for observation. There is nothing more annoying, to a zealous officer, than a poor observation of some position or movement of the enemy, which, but for the want of such simple means, he feels he might have made perfect.

The reconnoissances of signal-officers ought to be pushed to the utmost. The extent of the enemy's lines must be traced, if that is possible.

In the movements of great armies, when lines are miles in length, it is often of high importance to know their flank outposts. These must be discovered, if possible.

When the position of the enemy is known, it must be observed whether there are elevated points behind him, whence communication may be had, over his forces, to others on his front or flank,—these points being, perhaps, known to be in friendly hands. In such a case, signal-parties must be sent far round the enemy's flank to occupy them at every hazard. Reconnoissances carefully made and reported under circumstances of this kind, may be most valuable.

Signal parties of reconnoissance should gather information also in relation to the enemy, from the statements of citizens,—the inquiries being as to the numbers, number of guns, wagons, length of trains, and of the column; condition of supply in which the men seem to be, and the *morale*: other questions will readily suggest themselves. Different persons ought to be questioned on the same sub-

ject at points distant from each other, and their accounts compared, to see how they coincide.

When reconnoissances are to be made, it ought to be so arranged, if possible, that the results may be at once reported to some fixed station, from certain points agreed upon in the direction in which the reconnoissance is to be, and in view of the fixed station. The reports may go from this station by telegraph.

Certain hours of the day may be fixed for these reports, or the time may be estimated when the moving party will reach the designated station.

Preconcerted signals should also be arranged to be given; as by codes of Chronosemic Signals, prepared for rockets, cartridge-puffs, smokes, etc., to report such facts as ought to be instantly known, as soon as they may be discovered by the reconnoitring parties advancing. These signals are to be acknowledged from the observing station; and lines of repeating stations may be arranged when necessary.

In Indian wars the signalist must use much caution, making his observations from peaks, but keeping himself hidden, and signalling the results of his reconnoissance to the parties below from some nook or hollow, where his flag will be shut off from view except toward the observers. It is for reports of this nature that "position-signals," to be made with as little show as possible, will be found useful.

The general rules of reconnoissance given in standard military works furnish instruction as to the proper subjects for inquiry and observation, and the mode in which the inquiries and observations are to be made. These rules ought to be carefully studied.

A few suggestions are given for officers who have no recourse to complete works.

On reaching any point of observation, find from some intelligent countryman, hired or compelled to act as guide, the names and distances of all prominent houses, churches,

etc., in sight, and their computed distances from the station.

If water-courses are in view, in any direction, cause the guide to point out the course where the water is not visible, and also to indicate objects or points in view, some of which are on the near and others on the distant sides of the course. The movements or position of troops or trains visible may thus be referred to by these objects. Let the guide also show about where are the bridges and fords, to the end that the intention of forces moving near them may be divined. Let him be questioned closely as to the direction and condition of all the roads in view, and gain from him all possible information.

The location of cities, ports, or posts can often be exactly fixed by the appearance of one spire, or the top of a flag-staff, which comes into view; or by clouds of smoke or dust which, when the air is still, hang about it.

The courses of roads can sometimes be traced a long distance by dust rising above the trees, and by noticing the clear cuts through the trees where the road enters a forest.

To ascertain from a distance whether troops are in a town, it must be watched long and at different times of the day. Sentinels will probably be seen posted at some points, and the unusual number of men in the streets may give some information. Note if at any time in the day the horses are brought out by twos to be watered; and whether trains moving into the place stop or pass through it.

Observe whether there are pickets thrown out.

When columns of troops are moving very far off, it is often very difficult to tell whether they are troops, or how moving. Watch the line, to see if a break or spot at which it seems thinner can be found; and notice carefully, with the glass at rest, whether this spot moves, and in what direction. Look also for the glimmer of reflected light from muskets.

If any part of a marching force comes in view, by fixing upon a wagon, or some marked object in the force, and noticing the direction in which it crosses a line on a scale-glass, the glass at rest and fixed steadily upon it, the direction of the movement may be judged.

One gaudily dressed soldier, or a single mounted man, or any marked object, which can be distinguished from the mass, may fix the direction.

Clouds of dust should be scrutinized.

If the dust moves against the wind, or across the current of wind, there can be no question as to the direction of the movement; but movements miles away may give wrong impressions. For this reason the officer should always try to know beforehand, either by personal observation or study of the map, the roads on which the movements in different parts of the country must be. This aids the decision.

If dust rises in separate clouds, or is more dense at some points than at others, the clouds disappearing after a little time along a tract of road, notice two points at which the clouds rise one after the other, and deduce the direction in which the force must be moving, supposing it to be the same force which raises each cloud. In the same way, in a continuous cloud of dust, the clouds may rise more densely as the force passes points in the road more dusty than others.

Smokes may indicate the direction of a march. These are generally raised, from time to time, from cook-fires, teamsters' fires, or fires wantonly kindled by troops marching. If they rise further and further in any direction during the day, it is almost conclusive there is some movement in that direction. Smokes observed early in the morning, almost always rest over or near the camp from which they have risen.

Smokes should be carefully looked for after a rain, for

troops that have been wetted and are chilly will then light fires in disobedience of orders. In long-continued battles, concealed lines can be traced in this manner.

Smokes may sometimes be raised one after the other in particular directions to deceive; and clouds of dust are caused for the same purpose, by driving wagons over a dusty road. The work is apt to be overdone, and the clouds to be so dense and continuous as to excite suspicion.

Large bodies of troops are often marched through fields by the sides of roads, crossing the country in this way, and thus raising very little dust. Sometimes, under these circumstances, wagons may be in view moving in one direction upon the roads, while the troops march in opposite direction through the fields. When it is desired to know whether the enemy are or are not re-enforcing a position, movements of this kind require close study.

Troops and trains are sometimes marched in a circle, and are allowed to be seen at some point where they present the appearance of a very great force moving in one direction. If careful note is made of each regiment, battery, and train, as they come in view, they will, after a little while, repeat themselves in the same order. Notice, in suspected cases of this kind, some remarkable gun, wagon, or flag, and see if it returns from time to time to view; and look for the dust, etc., which ought, if the movement is genuine, to be raised far in the direction in which the column seems to be passing.

A force moving upon a road can often be computed when only a very small portion of the road is visible. It being known by the dust or other signs that troops are moving upon the road, turn the glass upon the visible part, and count each regiment, gun, wagon, etc., as it shows itself in passing. The length and strength of the column can be computed also by noticing its order of march, and the time it occupies in passing any given position.



A force encamped may be computed by counting the tents and estimating the occupants of each tent.

When any part of the enemy's force is thought to be moving at night, or there is a probability it will soon move, look out for the glare of its fires upon the sky. This glare may indicate its position, when the fires themselves cannot be seen.

Fires in view may indicate the position of troops at night. A rough computation of numbers may be made by allowing an averaged number of men for each fire.

An unusually large number and very bright fires may denote the presence of re-enforcements. Or they may be kindled to deceive. When the fires are in fair view, study them one by one with the telescope, and note whether persons are moving around them. When fires are kindled to deceive, they are often replenished at certain hours by details. If all grow dull and brighten simultaneously, there is room for suspicion.

If it is thought the enemy are about to evacuate any position, look out for signs of burning stores, etc. Notice if the smokes visible are of different colors, for this adds to the probability that they rise from burning stores. Stores of different kinds burn with differently colored smokes.

Notice whether trains arriving empty depart laden, and whether there are unusual movements of troops or trains from the position.

The destruction of railway tracks may be surmised if lines of smokes, or smokes rising at separate points for many miles, are seen. The smoke from burning railway ties generally appears in wreaths of white and black, the white arising from the steam of the moistened wood, the black from the seasoned timber. Unseasoned timber burns with a bluish smoke.

If the enemy are stationary, look carefully for their line

of pickets. Notice whether they are mounted or on foot. If mounted, it is likely they are some distance from any large force of infantry.

By carefully looking for the cooking-smokes by day, or the fire-lights by night, the whole picket line may sometimes be accurately discovered. Notice if this line differs at night from the day.

When an officer is stationed long in front of an enemy, he should endeavor to so closely observe his camps, works, strength, etc., that any marked change of any force will attract his attention.

Signal-officers will be greatly aided, and thus enabled to render more valuable service, if the commanding general, or the chief of staff, will from time to time send to them at their stations brief instructions as to the information they desire : as to observe particular tracts of country or particular roads ; to look out for indicated movements of the enemy ; to notice whether re-enforcements arrive by certain roads ; whether troops are moved in named positions, etc. ;—such instructions in general as the commander may think the facilities of observation at the stations will permit to be obeyed. Without this care, many facts may come under the observation of a signal-officer without mention in his reports, for the reason that he, ignorant perhaps of the position of our own forces, or of what are the presumed plans of the enemy, may not know the points upon which his commander desires to be especially informed, or the value of the information in his own possession.

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## MAPPING.

Outline maps should always accompany reports of special interest. These may be rapidly sketched ; and no matter

how roughly, if they are drawn with reasonable accuracy as to scales of distance and correctness of direction, and clearly lettered, they will be of value. They should be accompanied by copious descriptive notes and references, explanatory of the positions endeavored to be shown upon them: as, of the exact number of guns where a battery may be indicated; the number of tents in encampments shown; the apparent width and depth of streams, when water-courses are mapped; the size of villages, etc. The reports should also have full reference to the accompanying map, and both should be sent as soon as completed, by courier, to give more full information than can be transmitted by signals. A map can be drawn with very little care and labor by almost any officer, though he may be unskilled in topographic sketching.

Useful maps of any portion of a country can be furnished by "tracing," as follows. The officer, going into any section of the country, procures the largest and best map of that section he can; the more clearly showing water-courses, roads, and topography, the better. This map he carries with him to his station, with a number of sheets of thin tissue-paper, such as is used in manifold letter-writers. This is semi-transparent. He is supplied with a common pencil, and a red and blue pencil. The officer having selected his station, and recognized its position on the map, places over that part of the map a sheet of tracing-paper, and traces on it the lines of roads, woods, etc., showing through from the map beneath, and writes the names of places, or points to which he directs attention, being sure to always thus inscribe upon his transfer map the names of some well-known localities. On this map he marks the position of the enemy, so far as it is known to him.

In one corner of the tracing-sheet is drawn a scale of distances, copied or adapted from the original map, and the arrow indicating the compass-points. The water-courses are

to be carefully marked out and outlined with the blue pencil. The roads are traced in red.

The position of the enemy's camps, lines, redoubts, etc., are to be marked with the lead-pencil; these positions being carefully located upon the map by reference to the scale of distances. Full descriptive notes are then to be written upon the margin, or on an accompanying paper, and the map will be ready to be forwarded. These maps can be quickly made in the field, and their accuracy renders them useful.

#### MAPS AND SKETCHES FROM INFORMATION.

Maps or sketches from information, are maps or sketches drawn from descriptions given by prisoners, deserters, or scouts, and are for the purpose of setting forth clearly what else must be described with many words.

There is first to be prepared by the informant, or sketched by his direction, a rough outline or trace of the work, place, or thing described. He is then interrogated as to all particulars in relation to it. The answers are recorded in brief upon the paper bearing the outline—each answer being written near to that part of the trace to which it refers. Thus a line of works or a particular work being so first outlined, the informant is questioned as to the character of ground on which each part stands; its elevation, as referred to a river or some known point; the character of the ground in front of each part, whether it is cleared or encumbered, solid or soft, wet or dry; the distance to timber or other cover, from each part of the work; the number and calibre of guns—how placed—how mounted and protected; the structure of the work—positions of bombproofs and magazines, size and contents—location of traverses and quarters—where roads and what roads enter it; and so for questions which may be extended in proportion as the informant is intelligent and seems reliable. The answers thus obtained

afford such data, that if the outline sheet with these inscribed is placed in the hands of one used to topographic sketching, a complete sketch of the work, its contents and surroundings, may be made, and in such form as to present at a glance the result of the whole interrogation.

In the same manner may be had plans of the enemy's vessels building or within a certain harbor—of the forts and batteries covering the entrance—the guns bearing upon the channel—of obstructions—of torpedoes and their location, manner in which they are buoyed or to be exploded—of the channel, and of the sailing marks used by the enemy. This knowledge, embodied in maps or sketches accompanying reports, will be of value.

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## REPORTS.

The numerous brief reports which signal-officers must make of their observations ought to be carefully drawn. It should be the aim of the officer to indicate, by his reports, the thoroughness and deliberation with which he has done his duty. The report should state concisely and clearly what the officer sees, and what he thinks he sees, and he should be careful to state his uncertainty. When troops, camps, trains, etc., are seen and reported upon, their exact bearing by compass from some village, headquarters, or signal-station, certainly known to the general to whom the report is sent, must be given. The report should never describe any thing as seen on the right or left; the positions of things or the directions of movements must be always described by compass points. General terms, as large forces, small forces, etc., ought not to be used. The exact or computed number of the force must be given.

Signal-officers should particularly study to make their re-

ports minute. There should be included in the report the distance at which things are seen, the direction by compass in which they are, their number, their relative location; every thing that can tend to make the description perfectly intelligible to a person who, it must be remembered, may have no other information than the report before him, and perhaps a map with which to compare it. It must be considered that the reviewing officer has probably only a vague idea of the place at which the reporting officer may be, and that he does not know whether that officer faces, for his observations, east or west, or north or south.

The description cannot be too accurate. The report should always be drawn with the aid of a map of the country observed, if one can be had. The study of such a map will often enable a report to be made correctly, and to state decidedly as to where and on what roads forces seen must be, when this would be otherwise impossible. Facts gleaned from citizens should be given in the report; and every statement that the experience or study of the reporting officer may lead him to think can aid the commanding general in forming conclusions concerning the condition and plans of the enemy, ought to be fully made. It is proper for the officer to state briefly, at the end of the report, what it seems to him, from all he can see and learn, are the facts, either as to the position, condition, movements, or intentions of the enemy: always so stating these opinions, that they may be known to be his individual deductions from the information he has obtained, and the observations he has made. He should do this without timidity, aware that his report, with his deductions, will go before a general who, probably, has information from various sources, by which to estimate its correctness and its value.

To make his reports complete, accurate, and valuable, requires the highest attainments of the reporter; and to this end, the hours of leisure which come so often on stations of

observation or in camp should be devoted to the reading of works on general reconnoissance, the practice of mapping and sketching, and those companion studies of the military art which go to make the education of a skilful officer.

#### REPORTS FROM INFORMATION.

Reports from information are made by collecting in a report all the information gained from an informant or informants. Reports of information ought to be divided into heads: as, strength of the enemy—condition—organization—discipline—supplies—plans, etc. The matter under each head ought to have bearing on that alone.

When it is the duty of a chief signal-officer to collect information throughout a department—and this ought always to fall within his province—orders should issue by which an officer at each post in the command is made a correspondent, and printed forms of questions be supplied by which different informants coming in at different posts may be interrogated. The answers everywhere, being thus to the same queries, are capable of comparison and collation, to give connected information.

There is appended a copy of the order issued, and the form of interrogation adopted, during the war, in the military division of West Mississippi. In this division, condensed reports of information were required to be rendered by an officer detailed at each post, to the chief signal-officer, five times in each month. These reports were collated at general headquarters, for the information of the general commanding.

HEADQUARTERS MILITARY DIVISION OF WEST MISSISSIPPI, }  
NEW ORLEANS, LA., June 27, 1864. }

SIR—I have the honor to forward, by direction of the commanding general, the circular herewith, and to request that the duty of procuring, collating, and forwarding the information referred to therein,

be assigned to some particular officer at each post and station of your command, as a part of his regular duty; and that the name of this officer be reported at once to the Chief Signal Officer at these headquarters.

Should it become necessary at any time to relieve the officer in charge of this duty, his duties in this respect to be, prior to his relief, assigned to some other officer, and a copy of the order making the assignment to be forwarded to these headquarters.

The reports of information to be collated and to be forwarded on the 6th, 12th, 18th, 24th, and 30th days of each month, except in cases of such information as may seem of instant importance, when it is desired that the report be forwarded as soon as it is received.

These reports will be addressed, "Colonel Albert J. Myer, Chief Signal Officer, Headquarters Military Division of the West Mississippi, New Orleans, La."

I am directed further to ask that the substance of this communication be given as an instruction to each brigade commander of your command, and that copies be furnished for the guidance of the officer at each station, whence reports will be made. It is the object of this request to place the Chief Signal Officer at these headquarters in direct communication with the officers whom you may assign to this duty, with as little delay as is practicable.

I am, sir, very respectfully,

Your obedient servant,

By order :

ALBERT J. MYER,  
Colonel and Chief Signal Officer.

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HEADQUARTERS MILITARY DIVISION OF THE WEST MISSISSIPPI, }  
VICKSBURG, Miss., May 30, 1864.

Deserters, refugees, and other persons coming in at any military post in the Division of West Mississippi, or at any of the posts on the east bank of the Mississippi River, will be carefully examined by a discreet officer, and the information obtained from them compared and collated with that derived from scouts and other sources, and reported direct to the "Chief Signal Officer," at the headquarters of this Division, Natchez, Mississippi. Where this information is of immediate interest to any other commander, a copy of the report will be sent direct to that commander. The information thus obtained will be communicated only to division, department, or district com-



manders, except in the case of subordinate commanders specially interested, and will be confidential.

By order of Major-General E. R. S. CANBY.

Official.

C. T. CHRISTENSEN,  
Major and Assistant Adjutant-General.

[CIRCULAR.]

The following questions are furnished for the guidance of officers charged with the duty of collecting and collating information at the different posts within the Military Division of the West Mississippi; the answer to each question will be plainly written in the blanks appropriated for each, and the printed forms thus filled out, together with such tracings and drawings as the officer can obtain, and such general report as he may be able to make, will be forwarded to the "Office of the Chief Signal Officer, Headquarters Military Division of the West Mississippi, New Orleans, La.," on the 6th, 12th, 18th, 24th, and 30th days of each month:

Name? Rank? Regiment? Brigade? Division? Corps? Captain of company? How many companies in regiment, (full or small?) Colonel of regiment? What other colonels in your brigade? How many regiments in your brigade? General of brigade? What other brigadier-generals in division? How many brigades in division? How many regiments in each brigade? Where is the headquarters of your regiment? Where is headquarters of brigade? Where is headquarters of division? Where is general headquarters? Where did you encamp last night? Where night before? Where night before that? Where is or was general, (each general?) Where last heard from? How heard from? How many men with him? What were the rumors and reports? How did you hear each? Where was your division, brigade, regiment, and company going? When? How did you hear it? How did you come within the lines? How many were in your party? How many were taken? Were you scouts? Where did your regiment encamp last night? Where the night before? Where the night before that? Where is (each regiment of your brigade?)

QUESTIONS AS TO CHARACTER OF THE COUNTRY, CONDITION OF CROPS AND FORAGE, CONDITION OF THE PEOPLE.—Where—Depot of supplies? Depot of ordnance? Condition of railroads and telegraphs?

**OF WORKS.**—Number of guns? Calibre and kinds? Height and thickness of ramparts? How many? Depth of ditch? Wet or dry? Where are the magazines? How made? Where are the bombproofs? How made? How large? What kind of ground in front of works? Is it cleared? How much slashed? Is it swampy? Wet or dry? How far from the works are the woods? In what direction? What kind of woods are they? What kind of roads lead into the forts? What are they? What roads pass it? Describe them. Is ground sandy or clay? Is ground high or low? How do they get water? from wells, or springs, or river? Can you draw the trace on paper? Mark down the guns, traverses, bombproofs, wells, &c. What kind of carriages? Any pivots? Have they large or small wheels? Are the guns "en barbette"? Are they field-pieces, or guns of position? Are the works entirely inclosed, or are they built like works for field-pieces, with entrance for battery to be driven in? Have you ever been in magazine? Is it full? How many rounds to a gun? Commissary stores in fort—much or little—quality and kind? Your regiment has all same kind of guns? What kind? How many batteries or pieces in your brigade? Who commands artillery? Character of guns? How much cavalry in your brigade? How many regiments? How much in division? How armed? Where comes from? What rations do you get? Where from?

**NAVAL FORCES.**—Ships or vessels—how many? Steam or sailing? Side-wheel or screw? Built of iron, or altered? How old? How strengthened on inside? by wood or iron? How much water does she draw, all on board? What kind of wood is she built of, pine or oak? How long was she building? How long is whole vessel? How wide? How deep? How high above the water? How long is casemate? How wide? How high? How built? How iron-clad? What size are plates? How long? How wide? How thick? How put on? What kind of iron? How thick is wood-work? How built? What kind? Pine or oak? When and where was she plated? How many ports? Where are they? Bow ports, broadside ports? How are port shutters arranged? How large are ports? How high above water-line? Do the port shutters swing from top or side of ports? Which side? Do they slide up and down in grooves? How thick are they? How are they made? How thick is plating on the bow? How thick on sides? How thick astern? What is her weak point? Where her strongest? Is her deck plated? How? What kind of iron? How thick? How se-

cured? What are the means of getting on deck? How secured? How is she defended from boarders? How many smokestacks? Where situated? Has she a pilot-house? Where is it? How protected? How many boilers? New or old? Where are they? How large? How protected? What kind of engines, new or altered? What power? High or low pressure? If old engines, how are they altered for application of the propeller? How many pounds of steam? What ventilation has she? How many guns? Are they the same kind? What are their calibre? Where is her magazine? Have you ever been in it? How much ammunition has she on board? What kinds? Where was her ammunition made? When was she supplied last? How large is her crew? What nationalities? What is the discipline? Is there any disaffection among them? Where is her wheel? How protected? Where is her rudder? How far under water? How is it managed? Ropes or chains? Where do these pass? Has she a ram? What kind? Describe the shape? How long? How made? How attached to the bow? How far under water? Is it iron-clad? What is her best speed? Her ordinary speed? Does she answer her helm readily? Has she any tenders? How many? What kind? Who commands her? Did he belong to the old Navy? Has he had previous experience? Give a list of the officers' names on board? What are the general expectations regarding her? Does she intend to attack, or act on the defensive? Will she act alone or in concert with other vessels? What other vessels will act with her? Describe them (as above). What is her plan? How many masts? Are they intended for sails? Where are they situated?

UNFINISHED VESSELS.—Are there any unfinished vessels? Are they new or being altered? Where are they being constructed? When were they commenced? Are they working on them now? How many workmen are employed? Of what kind of timber is she being built? Will they have rams? Are the rams attached to the bows before launching? Are they to be iron-clad? Where do they get the iron? What kind of iron is to be used? How thick will be the plates? How wide? How long? Are these vessels screws or side-wheelers? Where do they get their engines? What kind of engines are they? Where are they made? Where repaired? What is the shape of these vessels? How long? How wide? How deep? How many guns will they carry? How much water will they draw? How thick will be the wood-work on the bow? On

the sides? On the stern? How are they to be strengthened inside? How many boilers will they have? Old or new? How large? Where will they be placed? How protected? Where will the engines be placed? How protected? Can you draw a trace of these vessels?

Induce the informant to draw a trace of such vessels and other objects as he describes, which will be sent with the report to this office.

In addition to these reports at stated intervals, which relate rather to the general military condition, a daily report of information should be made to the commanding general; and special reports should be prepared as often as any especial circumstances require them. The retained copies of these reports afford at once a kind of history of the war and of the information on which a general has acted.

#### TRANSMISSION OF REPORTS.

It is essential that the reports of signal-officers should be transmitted with rapidity. To gain time should be a chief consideration. The reports are generally of a character relating to facts actually transpiring, and if they are not known to the proper authorities at once, they are useless. For this reason, minute arrangements ought always to be made beforehand, if possible, that the reports may come at once, by signals or by telegraph, from the post of observation to the headquarters of the general commanding. The reporting officer must also, at his discretion, dispatch written reports, with maps, giving full information. There should never be delay. The report should go by messenger at any time, rather than incur the risk of losing value by detention. When, as sometimes happens on the field of battle, or in minor advances, etc., the report is of local importance only, and action on it would probably be taken by immediate commanders, copies of the report ought to be

sent quickly to the nearest regimental, brigade, division, and corps commanders. Care must be taken to sign the report clearly, with the name and rank of the sender. A copy of each report should be kept. The chief signal-officer of the army corps, to which the reporting-officer is attached, and the chief signal-officer of the army at general headquarters, must be furnished daily with copies of all reports, for the information of the generals commanding. It is the duty of these officers to make, every evening, a consolidated report from all the detached reports which have reached them, of all information of any kind which has been received at their offices during the day: the chiefs with the corps basing their reports on those of their subordinate officers, and the chief at general headquarters consolidating for his reports those received from the chiefs of corps. The corps chief submits his report to the corps commander, and sends a copy to general headquarters. The chief with the army submits his own to the chief of staff, or to the general commanding. Chief signal-officers, in submitting a report, give their views in reference to the accuracy of its parts; the reliability of the reporting officer; the concurrence of statements coming from officers observing at different parts of the line; the opportunities for correct observation had at different signal-stations: and they state facts within their knowledge, by which the value of the report may be judged.

The consolidated report from each chief signal-officer of corps should be sent in to general headquarters each day, before the chief signal-officer of the army makes his general report; and it should be accompanied by outline maps, if possible. In this manner, the general commanding has before him, each night, a summary of all the information gained by the signal corps during the day, and can estimate its value by comparison with information from other branches of the service.

## ORIGIN AND GENERAL USES OF SIGNALS.

Every intelligible word, sound, or motion is a signal. If, at the creation, our first parents were not endowed with a complete language, their first attempts at conversation must have been by simple codes of signs and sounds. The sounds uttered by the beasts of the field, or by the birds of the air, intelligible to them, are their signals and their language. To say of a well-tamed brute, as we sometimes do, "it can do all but talk," is an error in terms. It conveys ideas in its own language-signals, and, for its kind, as readily as we, who, more gifted, have more elaborate word-signals.

There is no difficulty in understanding the warning conveyed in the growl of a good watch-dog, or the affectionate speech of a horse at the sight of a coming master; and they recognize our signals of speech, and cultivate the memory of them, until they understand our words of praise, of threatening, and of command, as do human beings. So birds and beasts call and warn and soothe each other in their language. A hen, with her brood of chickens, affords us an instance. We hear the signals—a language—the call and the reply, expressions of pleasure, of warning, of condolence.

Speech—articulated sound having meaning—is producible by things inanimate as by the animate.

We have tried to show that skilful officers can make steamships converse by their steam-whistles; and at their first meeting in codes of signals—of whatever style, and in language of whatever nationality. Electric telegraphic instruments daily deliver addresses on every imaginable subject. A speaking automaton, a thing of wood and springs, is only a higher order of signal-machine. If there seems any thing of novelty in these statements, it is due to our habit of regarding speech as something difficult, and as an especial attribute of humanity.

Our own language is the elaborated code of signals we have chosen to adopt, and in which we perfect ourselves, to express our ideas. It is evident we can, if we so convene, express these ideas by any other code of signals. The origin of signals was at the origin of language.

With the first men it was, possibly, as with children learning to talk. First there are the few simple sounds, or speech-signals, by which the child expresses its limited wants, and which are understandable by those much associated with it only; then are daily new wants, and new expressions learned from those surrounding are added to signify those wants. Children learn to talk more rapidly when surrounded by talking children. Each contributes, from its store, language-signals to the information of the other. Afterward, as the wants increase and memory grows stronger, comes the incessant practice of language-signals—the constant communication with others—the study for years of their use and meaning, the writing of them to be read by others, and the investigation of those which, more rare, are kept recorded in books and dictionaries, until, in time, a certain mastery of the language is acquired. Then comes the study of other codes of word-signals—other languages; and the pupil finds the same meanings conveyed by different speech-signals, in the differing forms and expressions of the different languages.

So with men. First, there were, perhaps, a few simple sounds of voice, to indicate the scanty wants of the few then on earth, and these were understood among those few from their daily association. These were, perhaps, but single sounds, not sounds articulated, and the speech was possibly completed by physical signs. Then, day by day, came the gradual addition of new language-signals to express new ideas. The simple sounds—monosyllables—exhausted, it was necessary to join together two or more sounds in one expression to signify these ideas, and the single sounds so became jointed or articulated, and these were words.

With other wants of conversation, these words were placed together with the significations of nouns and verbs, etc.; thus were formed sentences. With larger populations, their wants, their pleasures, and their duties, was formed a complete spoken language.

Such languages are to-day found with many tribes which keep no written records, and whose speech is of a few spoken words, eked out by physical signs.

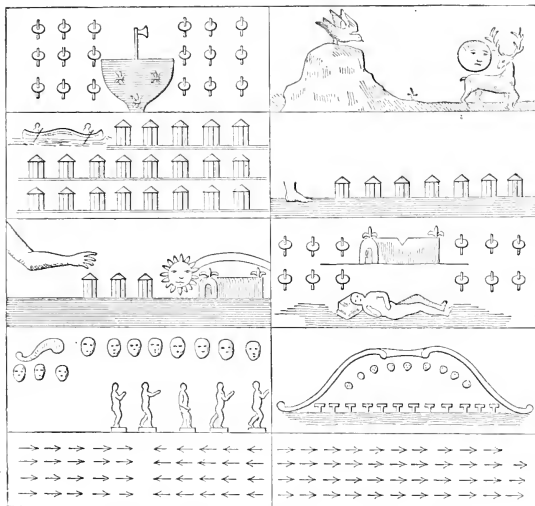
Afterward came the want of a written language. Perhaps some early hunter found he could state the number of his party by counting off or laying aside an arrow for each hunter; and as the arrow moves in the direction in which is placed its head, he could so tell those to come after by placing in the path a number of arrows—say five, for instance, pointing in a certain course—that by that path, and moving in that course, had passed five arrow-bearers or hunters.

Then would come very naturally afterward, for a similar purpose, and to have a similar meaning, the notching of the number of hunters, a notch being made for each on the shaft of a single arrow rightly placed. Then, by and by, for convenience, would come the use of a number of arrow-heads alone, pointing in the proper course, or the use of a single arrow-head with a number of marks upon it. Then, perhaps, for the next step, a rude drawing of the arrow-heads on rocks or on the bark of trees, or on skins, to show the number of hunters and the direction in which they had gone; and this would be naturally enough accompanied by some resemblance of the animal the hunters had followed. This is word-picturing, as it is practised now by the Indians of the western prairies, who give their pictured histories of hunts and battles—written histories to them—with sufficient data to make them a record, in sketches on the walls of caves, on pieces of bark, and on the skins of animals.

An example of the skill attained by practice in this art is



given in the following dispatch, said to have been sent by a tribe of North American Indians, who assisted the French forces during the war between France and England :



The following divisions explain those on the plate :

1st. Each of these forms represents the number ten. They all signify that eighteen times ten, or one hundred and eighty, warriors took up the hatchet, or declared war, in favor of the French, which is represented by the hatchet placed over the arms of France.

2d. They departed from Montreal, represented by a bird just taking wing from the top of a mountain. The moon and the buck show the time to have been in the first quarter of the buck-moon, answering to July.

3d. They went by water, signified by the canoe. The number of

huts, such as they raise to pass the night in, shows they were twenty-one days on their passage.

4th. Then they came on shore, and travelled seven days, represented by the foot and the seven huts.

5th. When they arrived near the habitations of their enemies, at sunrise—shown by the sun being to the eastward of them, beginning, as they think, its daily course—there they lay in wait three days, represented by the hand pointing, and the three huts.

6th. After which they surprised their enemies, in number twelve times ten, or one hundred and twenty. The man asleep shows how they surprised them, and the hole in the top of the building is supposed to signify that they broke into some of the habitations in this manner.

7th. They killed with the club eleven of their enemies, and took five prisoners—the former represented by the club and the eleven heads, the latter by the little figures on the pedestals.

8th. They lost nine of their own men in the action—represented by the nine heads within the bow, which is the emblem of honor among the Indians—but had none taken prisoners, a circumstance they lay great weight on, shown by all the pedestals being empty.

9th. The heads of the arrows pointing opposite ways represent the battle.



10th. The heads of the arrows all pointing the same way signify the flight of the enemy, followed by the arrows of the victors.

With the common and every-day use of picture-writings a few marks hastily made would gradually come to be understood for any determinate figure, as that of an animal. These are hieroglyphs, and the picture-writing would become a writing of hieroglyphs.

With many records, there would come the writer's skill in this art, and persons whose time was devoted to improve the style and compactness of each hieroglyph. The art of picture-writing would be thus perfected. But the hieroglyphic pictures would still express only completed ideas. So ingenuity would be taxed to satisfy the want—each day increasing—to be able to write down, word by word, spoken language, and to be able to convey, on record (in writing),

the precise words, with all their shades of meaning, it was wished to note as having been spoken, or to transmit, in a written message. So then at last, perhaps, some scholar or writer used to analyzing hieroglyphs, to find the meanings they convey, by studying the elementary marks of which each is formed, would analyze spoken words, having in view to write down a sign for each word. He recognizes that all spoken words are only certain simple sounds articulated (joined), devises a hieroglyph or written sign for each sound, writes down these signs (the letters), and a written alphabet is formed.

To show what sounds are joined together to form an articulated word, these signs are written, one after another, joined together, and written language is attained.

The form of the letter S, representing the snake,  whose hissing is the letter's sound, is perhaps as apt an illustration as can be selected. This snake character can be traced in the form of this letter in the alphabets of many languages. Thus, the Greek Σ can be easily imagined as a serpent hissing and about to strike. 

Another example of the process by which hieroglyphic pictures may become characters is had in the numeral letters. These indicate the digits or fingers, and we recognize the pictured "one finger, I, one," "two fingers, II, two," and so to "five fingers, the hand or V," which represents the outline of the thumb and little finger of the outspread hand—the thumb-mark thicker than that for the little finger. Then "a hand and one finger, VI, six," and so to "two hands, VV, ten, or X," the little finger-mark of one hand joining and crossing the thumb-mark of the second.

The rude efforts which attended the first attempts at tele-

graphing are subjects of study as interesting as that by which may be traced the origin of language for conversational uses.

Oral and written language perfected, there came the want of a perfected telegraphy, or the power to talk and write at a greater distance than the voice could be heard, and when written messages either could not be sent, or not with sufficient rapidity.

It was needed to so devise language-signals that they might be made intelligible at great distances.

A rude telegraphy by signs addressed to the eye, numerous, and largely used to help out the then imperfect language, must have existed from the time the earth was inhabited. Extensive codes of this kind are now in general use among the Western Indians. The following extract is from General Marcy's "Life on the Border." \* \* \* \* \*

"Their language is verbal and pantomimic. The former consists of a very limited number of words, some of which are common to all the prairie tribes. The latter is used and understood with great facility and accuracy by all the tribes from the Gila to the Columbia, the motions and signs to express ideas being common to all. This pantomimic vocabulary, which is exceedingly graceful and significant, when oral communication is impracticable, constitutes the court language of the Plains; and what was a fact of much astonishment to me, I discovered that it was nearly the same as that practised by the mutes in one of our deaf and dumb institutions that I visited. For example, there were some five or six boys directed to take their places at the blackboards and interpret what I proposed to say. I then, by pantomimic signs, told them that I went on a buffalo hunt, saw a herd, chased them on horseback, fired my gun and killed one, cut it up, ate some of the meat, and went to sleep—every word of which was written down upon the blackboard by each boy as rapidly as the signs were made,

excepting that all made the common mistake of taking the buffalo for deer."

The primary signs and sounds were perhaps like the "Symphenomena" described by Dr. Francis Lieber, instinctive to all human beings.

Meanings have been given to descriptive signs in the same manner that meanings have attached to sounds of words. Such signs would be used also to convey meanings at short distances.

In like manner would be adopted the raising of fires to convey signals of danger, or other information, by night, and the showing clouds of smoke by day; or the hoisting into the air of shields, or spears, or flags, or articles of clothing, and waving or putting them in motion to make them more visible, to attract attention, to indicate direction, or to give warnings. The signals by these plans had always arbitrary meanings, and were for limited uses only.

With later civilization came the need of systematized codes. War brought with it the necessity for telegraphic communication in armies.

Then were the first concerted plans. Then we read of lines of signal-fires; of long lines of men placed nearly together, who shouted messages each to the other, or who repeated, each in turn, the motions made by the other; of ingeniously contrived codes of messages, and of appliances by which to recognize the proper messages. There were attempts to construct rude semaphores. The plans were not yet formed for the transmission of letters and words, and few and preconcerted messages only were indicated. It was with a high civilization only that there came the idea of a telegraphy which could convey the phrases of a language. It was not conceivable without a written language.

It is interesting, looking back now, to study the perfection of the plans devised by the ancients, and to consider

how closely the rules underlying some of those plans and their working approximate the rules of the present day.

The most accurate accounts of signalling with armies, and of plans, which we know were practicable and constantly practised, are those found in the writings of the scholar and general, Polybius.

The first record of a signal corps, a regular organization of the armies of that day, comes down to us in the writings of that general, and in the histories of the wars in which he served. The devices of the army-signalling of that time—about two hundred and sixty years before Christ—seem to have been the invention of that general. They are traceable, perhaps, to a more remote antiquity. In the history of ancient wars, there are sentences which seem to indicate so general a use of signals in armies, that this is possible. Polybius gives the credit of the invention to Cleoxenes or Democritus, and claims only to have perfected the plans himself.

To us, however, Polybius stands as the inventor and the first officer who has given us an intelligible record of the services of a signal-corps of an army. This general arranged the letters of the Greek alphabet in five columns. (See page 123.)

To illustrate with the English alphabet, thus :—

	COLUMNS...	1st.	2d.	3d.	4th.	5th.
Letters, 1st.....		A	F	K	P	U
“ 2d.....		B	G	L	Q	V
“ 3d.....		C	H	M	R	W
“ 4th.....		D	I	N	S	X
“ 5th.....		E	J	O	T	Y
						Z

The apparatus (Plate XV, Fig. 8) was cumbersome and immovable. For field-work, the letters were displayed

literally in columns, for they were displayed on five separate posts or columns, set at each station, and numbered as one, two, three, four, and five. There were five letters on each post, and on the right and left hand sides respectively of these posts or tablets were two close fences, some ten feet long, and about as high as a man's head. At each station was an optical instrument, of two small tubes set close together, and so arranged that, while with an eye at each tube both fences at the communicating station could be seen, through one tube only the right-hand fence and through the other tube only the left-hand fence at that station were visible. This arrangement of the tubes was necessary, because at night the fences at the station to be viewed were invisible, and it could not be otherwise determined on which side the lights were shown. The five letter-posts, the fences, the tubes, and ten torches, completed the apparatus. It was of course to be used from fixed positions only. It was suggested to use the plan for night-signals, and it does not appear that it was considered as applicable to day-signals.

Messages were sent in this manner: The torches were lighted and hidden behind the fences. Then, to indicate the number of any letter-post or column, a corresponding number of torches were shown above the left-hand fence at the sending-station; while to designate any letter on that post, a number of torches, corresponding to the number of that letter as numbered on the post, were shown above the right-hand fence. These torches, as seen through the viewing tubes, were distinguishable as shown on the right or on the left, and were so recognized at the receiving-station. For instance: to indicate the letter J, that is, on the second column, the fifth letter, two torches were shown above the left, and then five above the right hand fence. For the letter K, third column, first letter, there were shown three torches on the left, and one on the right. For the letter C,

first column and third letter, one torch on the left and three on the right ; and so on.

With the skill of practice, letters were telegraphed after this plan with a good deal of rapidity. With a sufficient number of men on duty, the letters were shown as fast as they could be recognized. This device, appearing under different modifications, seems to have been used among all the armies of the East, and its use came down to times comparatively late. The principles of this plan enter the perfected systems of telegraphing of the present day.

For illustration :—

The written record of the letters arranged in tables, after the plan of Polybius, would be something as follows: "A" is "first column, first letter;" or briefly, "A" is "first-first," or "one-one," or "1—1," or "11." So of the letter B: "B" is "first column, second letter," or "first-second," or "one-two," or "1—2," or "12." The letter "G" is "second column, second letter," or "second-second," or "2—2," or "22." "N" is "third-fourth," or "34." "Y" is "fifth-fourth," or "54;" and so on. The letters could thus be condensedly written in numerals. It would have to be borne in mind that the left-hand figure of the numerals indicated torches to be shown on the left, while the right-hand figure of the same numeral indicated torches to be shown on the right. Now the record of the torches seen at night, representing these numerals, standing for letters, would be intended to show how many units—for each torch represents a unit—were signified by torches seen on the left, and how many by torches seen on the right. So "A" might be written, when seen signalled, "A" is "1 on the left" and "1 on right," or "11;" or, the torches shown on the left and those shown on the right might be indicated and distinguished by different figures, as a "1" to stand for each torch shown on the left, and a "2" to stand for each torch shown on the right. Then the record of "A" would be "12:" or, in a



hasty record, any other marks might be used instead of 1 and 2; as, a short mark for each torch on the left, and a long mark for each torch on the right. These might be placed upright, as “**1 1**,” or horizontally written, as a dot and a dash, “. —,” and we have a telegraphic letter. Or, the fact that a certain number of torches had been shown on the left and a certain number on the right, might be indicated in yet other ways, as by marks or dots placed before a *space* for the torches shown on the left, and dots after the space for those shown on the right. So the letter “B” might be shown in these several ways: as “12,” or “122,” or “111,” or “. —”. The letter “C” might be “13,” or “1222,” or “1 111,” or “. . .,” or “. ———.” The letter “H” might be “23,” or “11222,” or “11 111,” or “. . . .,” or “. . . . .”

We arrive thus at the principles of the telegraphic character.

The alphabetic plan of Polybius was an ingenious invention. The systematic application of the principle on which the letter-signals are devised, to general uses and to other modes, seems not to have been thought of, and it is possible it was not at all considered. Each signal was shown as a whole, and Polybius complains that “because every letter requires a double signal, a great number of torches must be employed.”

The fact exists, however, that he was working by signals of two elements, as clearly as that signals are made in that manner to-day.

In the wide study of and practice with these signals, this must have become generally known; and it seems as if glimmerings of the knowledge of the fact, that all language could be represented for telegraphing by any two elements, can be traced from the time of Polybius.

The principle understood, it will be seen how the plan might be applied, showing for any letter one torch a number

of times on the left, and then a number of times on the right screen, instead of a number of torches together on the left and on the right. With the optical instrument described, these signals would have been legible.

Flags, or other objects, might have been shown by day instead of the torches, or a single flag might have been shown in the proper places a proper number of times, instead of the single torch just mentioned. This seems not to have been thought of.

We can easily see how signals might have been made by swinging a torch into view on the left, and then on the right, from behind the screens. This mode would have differed from combining motion with signals, for the purpose of giving that great visibility which motion gives to flags or lights; for the whole swing would not have been visible, but it would have closely approximated that mode.

Field-signals are now made in our army by so swinging a torch all the time in view from side to side.

At the siege of Vienna, John Smith, the explorer of Virginia, used the plan of Polybius with effect, to arrange with the besieged forces for a sortie, he having learned it from the Turks, it is said. The quaint old English works of 1650, or thereabout, tell of a marvellous device by which those who know may converse so far as white can be known from black. This is evidently a code of two elements.

In 1812, a clergyman of England, reviving the table of Polybius, and giving to the letters the same enumeration, designated the number of the column by one torch, brought the proper number of times into view from behind a screen; and then, after a slight pause, indicated the number of the letter in that column by showing the torch as many times as made the letter-number. Extending the plan, he used the flashes of any kind of light.

Thus to make A, first column, first letter, or "1 1," one flash—a pause—one flash. To make C, first column, third

letter, or "1 3," a flash—a pause—three flashes. To make G, second column, second letter, or "2 2," two flashes—a pause—two flashes; and so on. The code is one of two elements; that is, flashes before the pause, and flashes after the pause.

Of course, the single light of any light-house can be flashed in this manner. Messages were sent by this gentleman a distance of forty miles.

A plan of flags by day is said to have been used, but whether in motion or at rest there is no information.

At a later day, in 1829, the intermural telegraph of Mr. SWAIN, of Philadelphia, of taps and scratches on a wall, is another development of the system of two elements.

Finally, the transmission of signals by electricity, the splendid telegraph of to-day, began to attract attention, and study was turned to provide the most available signals. Signals of two elements, traceable thus from the time of the ancients, are found in the right and left vibrations of the needle in the code of Schilling, whose letters are written left-right, or *lr*; or left-left-right, or *llr*; or left-right-left, or *lr l*; or left-right-left-right, or *lr lr*; etc. It is plain these letters may be written one-two, or one-one-two, or one-two-one, or one-two-one-two; and so on.

In later years, this code of signals, modified and sometimes so changed as to be hardly recognizable, is used in all the signal telegraphs of Europe. When signals came to be traced on paper, a code of two elements was written by dot and line.

In the time of Polybius, and through most of the Greek and Roman wars, there were corps of signalists or telegraphers with the army. These were known as *πυρσευταί*. The word has been translated "fire-bearers;" it is literally "fire-movers," or "fire-shakers," or, perhaps, "fire-swingers," from *πυρ*, fire; *σεωω*, to move, to shake. In the history of the siege of Agrigentum—a town from which though perfectly

invested, the commanding officer was telegraphing the condition—the narrative is given: “But Hannibal (*διαπυρσευόμενος*) shaking through with fire, or swinging through with fire, and sending through messages continually that the people could not stand the famine,” etc. How this was done we are not explicitly told, and of the precise meaning of the word we cannot be now assured; but, reading the quotation, we seem to read of the service of the Signal Corps of our army, and to trace the working of the torchmen of to-day.

We can thus evolve from this plan the principles upon which are based electric-signals, the flag-signals of the General Service Code, and those which underlie the Homographic Codes heretofore illustrated.

It is difficult to realize that, in the perfection of telegraphs and telegraphic signals, are revived almost the oldest devices of antiquity; that the fire-swingers of Polybius and the signalmen of our army practise so nearly the same art, with modes so closely assimilated; that the electric telegrapher writes his signals with the same elements, and perhaps with almost the same characters, with which the first telegraphic signals of which there is record were noted.

The telegraphic apparatus of early days were not often portable. The devices show ingenuity of invention, but they were not applied by practicable rules. The use of the telescope was wanting, and the art, with all the development given it in armies, did not attain a great perfection.

In the Dark Ages, the art of telegraphing seems to have been lost with other arts. Few knew even how to read and write, and the rude habits of the time required no perfect telegraphy.

The very idea seems to have been so far forgotten, that the introduction of semaphores, which came with a much revived civilization, was opposed as a sin against the Deity. The introduction of electric telegraphs was opposed by the

ignorant ; and up to quite recently, it has been held singular, even by those of education and large experience, that any man should be able to talk to another by a few simple signs as far as he could be visible.

In the study of the subject of telegraphy, there are everywhere met the devices by which, in later days, the end was sought.

In naval signalling, we read of strange plans, as of hoisting a barrel at the yard-arm as a signal for water, or a tablecloth as an invitation to dinner. Then of slow improvements : attempts to build semaphores on ships ; complicated arrangements of signal-flags ; but with gradual improvement, from year to year, until we reach the flag dictionary of to-day.

In telegraphy on land, we trace again from the days of signals by fires and smokes to the time when a few simple signs were given by the commander's flag upon the field of battle ; then cumbrous semaphores worked on rude plans ; then the wonderfully ingenious plans of Chappé ; then the portable semaphores of Popham, and the efforts to represent semaphores by men holding disks in their hands ; and so through hundreds of devices, ingenious, but without systematic application, down to the crowning invention of the electric telegraph.

On land or on the sea, the aim of inventors in general has seemed to be to signify the numeral digits by signals, and then to designate by these the particular messages in Codes of Messages.

In contemplating some of the plans, we consider with wonder the labor to attain ends which, with better knowledge, are reached by means so much more simple and available.

A difficulty seems to have been in the fact that, working without systematized rules, each signal was arbitrarily formed ; and in almost every case, the effort was to make

all signals complete of themselves and permanent. The plans for transient signals, or signals whose parts were to be made in succession, and by certain rules, and for the rapid verbal telegraphing now demonstrated to be practicable, and with so little trouble as to hardly require tuition, have been of more recent origin.

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The signals of the earlier times seem to have had a relation to a perfected telegraphy similar to that which spoken words had to a written language. The elements of signals were to be determined by study, as were the elements of words, before general plans could be devised by which to so exhibit them as to convey any meanings of a language.

The systematizing of signals by plans in which each possible elementary sign is first arrived at, and is then so symbolized by some given character or figure that these may be written, and may show all the combinations or arrangements which can be had, using any of the elementary signs, is to the study and improvement of signals what the invention of written language was to that of words. When words could be considered only as complicated sounds, of which there was no record, or but an arbitrary one, language was confused, and imperfectly learned by years of labor.

The invention of the alphabet made the study easy, and permitted a progress else impossible. It has been thus with signals. While complicated signals were arbitrarily used to express ideas, the study seemed full of mystery and labor, and few were able to give it attention. But when we consider signals as made up of simple signs, and have plain rules by which to write these down and put them together, as letters are joined to make up words, the study becomes so easy that any one can be a proficient; and the science can be perfected to a degree before impracticable.

## GENERAL USE OF SIGNALS.

There have long been dreams of a Universal Language, by which men of any nation might converse; and the idea has occurred to many, that systems of signals might be so planned as to be universally applicable.

The subject has excited no general attention, because it has not been pressed upon the notice of the public. The difficulties to be encountered have originated in the general ignorance of the subject, and in the complications of the proposed modes of signalling.

Very few persons without experience, have any idea of the ease with which alphabetic signals are made, or of the remarkable ranges at which signals, made by motions, are visible to the naked eye. They still less realize the almost wonderful gain had by the use of a simple pocket-telescope. Signalling at five miles is held, by experienced signalists, to be at very short range.

Messages have been sent ten miles with a pocket handkerchief on a twelve-foot rod. With the flags and staff in use in the Signal Corps of the Army, communication is said to have been had at twenty-five miles distance; and detached words are reported to have been read at a distance of forty miles.

Almost any person who can read and write well can learn, with a few hours' study, to converse by signals as far as he can be seen with a telescope. He can make himself understood using a cane and a handkerchief, or a rough pole and a piece of any cloth, as a coat or a shirt, or sometimes his arms only, at distances of five or six miles. He can communicate easily at a distance of one or two miles when no telescopes are used. Preceding illustrations have shown how common lanterns, or any lights, can be used at night, and how it is almost impossible for the signalist to find him-

self, in any of the chances of life, without such things as may make up his simple apparatus.

It is needed only that some alphabetic code should be adopted and be generally known. It must be so written out and explained that the untutored can comprehend it. The principles upon which it is founded should be clearly stated.

The same code ought to be used everywhere, by nations of the same language. It should be, if possible, committed to memory. It should be taught in schools, and all institutions of learning. It is as easy to commit to memory, and to retain, an alphabet in which the letters are known by numbers, and the motions for them, as the common alphabet, in which each letter is known by its name. Children can acquire such a code as soon as they have learned to read.

Persons of mature years can easily devote sufficient time to the subject to comprehend the working of the code in case of necessity. At academies and colleges the practice of the code could be made a part of the course of instruction; and the students would find a healthful and pleasant field-practice in an art which will give them a new power, and in learning which they would incidentally acquire that practice with the telescope and knowledge of its uses which opens almost a new world of view to the possessor.

To be able to thus telegraph at will, would add to the pleasure as well as the safety of the individual.

At military and naval academies, where all manly acquirements and all knowledge that can add to our powers of offence or defence are expected subjects of study, this art, on the acquisition of which the possession of a fort, or of a ship, or even the fate of a battle may hang, ought to be taught as of course: precisely as a pupil must learn the manual of the musket.

There is hardly an officer who has seen service but can



remember instances at which, if he and his fellow-officers had possessed only so much skill as follows a few hours' practice, it might have contributed to the success of an expedition or an engagement. There are few who will not admit the propriety of acquiring the information.

The commanders and officers of merchant and revenue vessels have frequent occasions for such communication. Surveyors might use it when running long lines. There are no circumstances under which men may need to act in concert, but in which this practice would be valuable.

There is nothing visionary in the proposition of this universal knowledge. Any one can acquire it. The applications of it would be endless.

How many instances can every one recall in hunting or boating, in travel, or in the plays of childhood, or in business, in any of the pursuits of peace or war, when the power to signal a message a few miles, or a mile, or even a few hundred yards, would have been a most valuable acquisition! Or with more sad recollection, how many instances can most recall where, on wrecked ships, or at fires, or in the thousand occurrences of peril to life, their fellow-men have perished, helpless, for want of a few words of information, which might have been signalled to them!

There are those who, remembering these facts, would accomplish themselves as signalists, as a duty, for the sake of their own safety, or that some day they might aid to save others.

The modes of diffusing the information are easy.

Codes can be written with intelligible instructions, and so plainly, that by using them almost any one can make and read signals, and this to the extent of sending any brief message they choose, with less than an hour's practice.

These Codes, with all the instructions, can be printed on a piece of card-board not much larger than the hand. If

## GENERAL SERVICE CODE.

A flag is held directly above the head.

To make letters, swing it to the ground, on the right and left sides, as follows :

Letters.	Motions.	To make Numbers.	Letters.	Motions.	To make Numbers.
A.....	left, left.....	22	O.....	left, right.....	21
B.....	left right, right left.....	2112	P.....	right, left, right, left.....	1212
C.....	right, left, right.....	121	Q.....	right, left, right, right.....	1211
D.....	left, left, left.....	222	R.....	left, right, right.....	211
E.....	right, left.....	12	S.....	left, right, left.....	212
F.....	left, left, left, right.....	2221	T.....	left.....	2
G.....	left, left, right, right.....	2211	U.....	right, right, left.....	112
H.....	right, left, left.....	122	V.....	right, left, left, left.....	1222
I.....	right.....	1	W.....	right, right, left, right.....	1121
J.....	right, right, left, left.....	1122	X.....	left, right, left, left.....	2122
K.....	left, right, left, right.....	2121	Y.....	right, right, right.....	111
L.....	left, left, right.....	221	Z.....	left, left, left, left.....	2222
M.....	right, left, left, right.....	1221	&.....	right, right, right, right.....	1111
N.....	right, right.....	11			

## EXPLANATION.

The numbers for each letter are made by motions.

The whole number opposite each letter stands for that letter.

There are one position and two signal-motions. Any letter can be made by these two motions.

Provide a flag of a piece of any cloth, with a pole about ten feet long—a slate and pencil to write the signals—a spy-glass, or a marine glass.

To prepare a message : write the words on a slate. Then write for each letter either the numbers which stand for it, or the "motion-words" as for A either ("22"), or ("left, left"); for B either ("2112"), or ("left right, right left"), inclosing each in brackets. When the message is thus written out—

## TO SEND A MESSAGE.

Face exactly towards the person to whom you are sending.

Hold the flag directly above the head. This position is called the "First Position."

Make the "Attention Signal."

Wait until this is answered by the other party with the "Assent Signal."

Then signal the message letter by letter, reading the "Motion-words" for each from the slate, or having them read by another person.

To make motion one, or "1," the flag is waved to the ground to the right, and brought back to the first position. To make "motion two," or "2," the flag is waved to the ground to the left, and brought back to the first position. Thus to make "A," or "22," or "left-left," the flag is waved twice to the ground to the left and is then brought to the first position. To make "B," or "2112," or "left-right-right-left," the flag is waved once to the left, twice to the right, and once to the left—that is "left right, right left." To make "222," the flag is waved "left, left, left." And so for the Alphabet.

The motions for any letter are made without any stop between them.

At the end of each letter pause two seconds, holding the flag above the head.

At the end of each word wave the flag to the ground directly in front, and bring it back to the first position.

At the end of each sentence wave the flag twice to the front, and bring it back to the first position.

At the end of a message wave the flag three times to the front, and lower the flag.

The "Attention Signal," to call attention, is made by waving the flag from side to side over the head and to the ground continually.

The "Assent Signal," meaning "we see you, and are ready for your message," is made by waving the flag to the left, two waves at a time, three times (left left—left left—left left).

The "Repeat Signal," meaning "message not understood : repeat it"—the flag is waved thus : (right, left, right—right, left, right—right, left, right.)

## TO RECEIVE A MESSAGE.

The telescope or other glass must be at rest, and still. The Signal Motions, viewed through the glass, will appear, the "one motions" toward the *left* side of the field of view—the "two motions" towards the *right* side of the field of view. They are called off as "one" or "two" as they are seen made, the numbers of each letter together if possible, and are written upon the slate. Thus A would be called "two, two," and written (22) B is "two one, one two," and is written "2112," etc. A dash at the end of each word—two dashes at the end of each sentence. The letters may be interpreted by reference to the card.

Messages may be sent without apparatus by swinging a handkerchief, held in the hand, or by swinging the right arm for one, and the left for two, following the rules.

the instructions are very full, the card might be six inches square.

The General Service Code of two elements, and the General Service Homographic Code, printed upon cards, as here illustrated, afford examples of such codes.

The alphabet may be printed as in these instances in column, or in a circle on a disk. The object of the arrangement is to bring each letter and its signal-number closely together, that any letter and its signal may be seen at a glance.

The Codes may be written more in full, and with fuller explanations.

If the reader can comprehend these rules, and will practise a few moments with a companion, he will surprise himself by sending messages correctly. After this, he need only practise with the flags, and with the telescope in the open air, to make himself skilful. It is very probable that the knowledge he can gain will be sufficient to enable him to slowly signal, or to read a message at any time.

A person once thoroughly practised as a signalist can thereafter send and receive by any code that may be before him.

The card form is useful for the reason that it keeps before the signalist, and in compendious form, not only the signal-motions and the numbers for each alphabetic letter, but the general rules for their transmission. With a little practice, it will be found that the Signal Alphabet is in this way easily committed to memory, and thenceforth reference to the card will not be necessary.

It has been endeavored to draw this card code with instructions so plain that no person, however unskilled as a signalist, need fail to comprehend them; or, if by chance they should appear complicated to any, the briefest instruction from a practical signalist may remove the apparent difficulty.

## FRONT VIEW.

GENERAL SERVICE CODE.  
ARMY AND NAVY.

Homograph.	Flag.	Homograph.	Flag.
11.....A.....	22.....11	43.....N.....	11.....21
21.....B.....	22.....2112	53.....P.....	21.....1212
31.....C.....	121.....121	14.....Q.....	1211.....1211
41.....D.....	222.....222	24.....R.....	211.....211
51.....E.....	12.....12	34.....S.....	212.....212
12.....F.....	2221.....2221	44.....T.....	2.....2
22.....G.....	4.....4	54.....U.....	112.....112
32.....H.....	122.....122	15.....V.....	1222.....1222
42.....I.....	1.....1	25.....W.....	121.....121
52.....J.....	1122.....1122	35.....X.....	2122.....2122
13.....K.....	221.....221	45.....Y.....	111.....111
23.....L.....	221.....221	55.....Z.....	2222.....2222
33.....M.....	1221.....1221		

## FLAG SIGNALS.

Signalman faces exactly communicating station—Flag is held directly above the head—but of staff at the waist.

Letters are signalled by making one after the other, the following motions for the figures standing for each letter. When two or more figures follow each other, there is no pause between the motions of the figures:

To make "one" (1) flag is waved to ground on right side, and brought back above the head.

To make "two" (2) flag is waved to ground on left side, and brought back above the head.

To make "three" (3) or FRONT. flag is waved to ground in front, and brought back above the head.

So to make "A" or "twenty-two" (22), the flag is waved twice to the ground to the left without any stop between the motions—so for a number of "twos" following each other.

To make "N" (11), "one" "one" (as above).

To make "B" or "twenty-one twelve" (2112), the flag is waved to the ground, "left—right—right—left."

To make "K," or "twenty-one twenty-one" (2121), the flag is waved to the ground, "left—right—left—right."

To make "three" (3) flag waved FRONT, to make "thirty-three" (33)—FRONT—FRONT. Error—2121. Repeat—121 121 3. Assent—22 22 3. End of word. 3. End of sentence, 33. End of message, 333. (Leave signalling—22 22 22 333.)

## REVERSE VIEW.

The flag is always above the head at the end of each letter.  
NIGHT SIGNALS.—A lighted torch or lantern "four high" is placed in front of and at feet of signalman. A torch light fastened at the end of staff is waved with precisely the same motions as those for the flag in the day.

## HOMOGRAPHIC SIGNALS.

The Dicks are held at the breast, one in front of the other, touching. The following positions are made with dick, or any signal held in the hand for each figure:

To make any number, the positions for the figures of the number are made one after the other, without pauses between them.

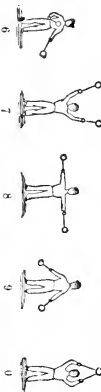
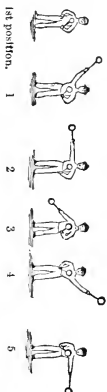
To make A, or "eleven" (11), make two ones.

To make M, "thirty-three" (33), make two threes.

To make (1), or "fifty-three" (53), make five—three.

To make 16, make one, and then six.

To make 24, make two—four, and so on.



Signals for "error"—"assent"—"repeat"—"yes"—"recognition"—"close of sentence"—"end of message"—are made by using a dick with the same motions that are made for those signals with flags.

## NIGHT SIGNALS.

A red lantern fastened at the waist—a white lantern held in the hands. Some motions and positions for signals as those given in the day. The figures for any signals in Boat Code, or Naval Signal Books, can be made as above.

The General Service Homographic Code, or any of the codes described in this manual, can be condensedly printed in this manner. The General Service Code for the Army and Navy here printed is a further illustration.

This card, intended especially for use of officers and those who have acquired some skill, may be perhaps too much condensed for general use. It may be carried in the pocket for reference. Upon it are condensed the Rules and Alphabets for both Day and Night Signals, and by both the General Service Code of two elements, and the General Service Homographic Code of ten elements. The numerals standing for the letters are in the columns opposite the letters they represent. The numerals in the first column are to be made by position-signals. The numerals in the second column are to be made by motion-signals.

For the Homographic Code it will require but few rules and very little practice to fix in memory the ten motions. They are pictured upon the card for reference. It can be learned in an hour to make together by twos—one after the other—the motions which stand for each letter, and to suit the plans for Day or Night Signals.

It is easier still to remember that in this code one wave of a handkerchief may stand for “1,” two waves for “2,” three waves for “3,” and so on; and to learn to signal the letters in this way: Thus, “A,” “11,” “one-one” (*one* wave—a pause—*one* wave). “B,” “21” “two-one” (*two* waves—a pause—*one* wave), etc. Longer pauses between letters and words. Flashes upon the same plan at night.

Both codes are given on the card, because, while the signals of the General Service Code by flags in motion are visible at vastly greater distances than those of the Homographic, it is sometimes easier to read the latter when a ship is rolling.

With these plans understood among nations, and such a signal alphabet furnished to all national and merchant ves-

sels, it would be necessary only to carry the dictionary of the languages of the different countries, to be able to converse, in its own language, with any vessel that might be encountered at sea, or with any post or port on shore. As the number of letters in the different languages vary somewhat, a dictionary, which would be a very complete signal-book, might be arranged in this manner: the dictionary to be polyglott, and to contain the synonymous words and terms of the different languages in which there might be occasion to converse; in the forepart of the dictionary to be printed the alphabets of the different languages, each having opposite its letters the signal-numbers by which they are represented. Such brief instructions as are above given, to be printed in the dictionary.

It will be evident to any one who has attentively read these notes, that a vessel thus furnished, and carrying the ordinary equipment of signal-flags and torches, need never have serious difficulty in communicating wants or wishes, or in conversing with similarly provided vessels or posts of its own nation, or of any other in the vicinity of which it might be.

It would require but little official action to establish the use of such codes upon the vessels of our own nation, and but little international action to render the usage universal.

It might be required by law that code cards be carried on every merchant or other vessel in the service of the United States. Similar codes ought to be furnished to every command, fort, post, life-saving institution, life-boat, light-house, and boat-station in the nation. At boat-stations, the keeper ought to be required to understand the code well; and upon vessels and at posts the officers should be practised in it.

The signal or cipher disk which has been before described may be arranged for the especial use of the officers of the land or naval service, and having a few rules printed upon

it, will furnish not only a secret code for their communication, but one which they may change to suit emergencies.

If any officer reading these lines will reflect that on skill so easily acquired may on any day rest, not only his own safety, but the safety of hundreds intrusted to his care, or even the success or failure of some great cause, he will find in this sufficient reason to acquire it.

There is a kind of intelligence, as of free-masonry, among those instructed in signalling who chance to see anywhere the motions of a flag waved by them to attract attention, answered in the distance with the waves "by twos," which indicate the presence of a signalist.

The general plans are taught, and have been used in our Army and Navy; it is easy to extend them to the vessels and officers of the Revenue Service and the Merchant Marine. They can be practised at institutions of learning on shore and on school-ships afloat. Boards of Trade and Life-Saving Associations can circulate them. The first lives that may be saved by a few words signalled in time, will more than repay the necessary effort.

The idea is no longer theoretical. The experience of the past war has demonstrated how easily signals may be used, and how generally they might be taught.

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It has not been intended to convey in this article that practice in signalling may be dispensed with. In this, as in every other branch of duty, the practice of those who have important offices in charge ought to be continual.

But it has been endeavored to direct attention to the great advantages to follow the general use of signalling in and out of the service, and to show how easy it may be to provide for such and so much of practice, that any one may fit himself for intelligent communication if emergencies come.

The advantages to follow the services of a well trained signal-corps, and the marvellous skill its members can acquire in all the branches of telegraphy, have never been better set forth than in the following quotation from the writings of the soldier to whom is traced the origin of such organizations more than two thousand years ago (POLYBIUS' General History, Book x., chap. ii.) :

"It is a thing well known that opportunity, which has so great a share in the accomplishment of all designs, has the greatest in those that belong to war. Of the wonderful inventions which have been contrived for securing opportunity, the most effectual is that of making signals by the means of lighted torches. By this method, things which have been just transacted, and others at the very time in which they happen, may be communicated to those who are concerned to know them, though they are distant, perhaps, three or four days' journey, and sometimes even many days from the place, and the requisite assistance be received when it seems scarcely possible to expect it. In former times, the manner of conveying this notice was too simple, and the invention upon that account lost much of its advantage, for the method was to settle by concert some fixed and determined signals. But as the things which happen are infinite, the greater part were incapable of being signified by such a method. It is not possible that signals should be concerted to give notice of events which cannot be foreseen. \* \* \* \*

"The last method which I shall mention was invented either by Cleoxenes or Democritus, but perfected by myself. This method is proved, and capable of signifying anything that happens with the greatest accuracy. \* \* \* \*

"In both these methods it is principally requisite that the persons employed should first be exercised by practice—that when a real occasion happens the signal may be made and answered without any mistake.



“With respect to the recurring difficulties of the method, it would be easy to show by many instances that there is a very great difference in the same things when they are first proposed and when they are afterward rendered familiar to us by habit; and that many things which appear in the beginning to be not only difficult, but absolutely impracticable, in the course of time, and by continued use, are accomplished with the greatest ease. Among numberless examples, the act of reading may be mentioned as one of the clearest and the most convincing proofs of the truth of this remark. Take a man who has never learned to read that is otherwise a man of sense; set a child before him who has learned, and order him to read a passage in a book. It is certain that this man will scarcely be able to persuade himself that the child as he reads must consider distinctly, first, the form of all the letters; in the next place, their power; and thirdly, their connection one with another. For each of these things requires a certain portion of time. When he hears him, therefore, read four or five lines together, without hesitation and in a breath, he will find it very difficult to believe that the child never saw the book before. But if, in reading, some gesture also should be added—if the child should attend to all the stops and observe all the breathings, rough and smooth, it will be absolutely impossible to convince the man that this is true. From hence, therefore, we may learn never to be deterred from any useful pursuit, by the seeming difficulties that attend it, but to endeavor rather to surmount those difficulties by practice and by habit. It is habit which gives to men the noblest acquisitions, even those which are upon many occasions the principal means of their safety.

“With respect to myself, what induced me to enter into a discussion of this kind was the remark that was made in a former account of the work, that in the present age the sciences are advanced to so great perfection that almost

every thing is capable of being taught by method. Such digressions, therefore, deserve to be considered as some of the most useful parts of a history that is well composed."

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In time of war, when large forces are assembled together, the following rules may be found convenient for rapidly diffusing the knowledge of a General Service Code throughout a command.

It is desirable that the commander of each post, vessel, or separate command, be so far informed in the principles of all signals, as to know what can be effected by them, and to be able of himself to judge when the duties of this description are skilfully and efficiently performed.

Two or more intelligent officers with each brigade, on each vessel, or at each post, to be selected by the commander, should be instructed in the different codes and modes of signalling—this instruction to be carried to such degree that those persons may in their turn intelligently instruct others with whom they may be ordered—a certain number of seamen or enlisted men to be instructed and habitually practised with these officers in the manuals of signals.

All officers should have such knowledge of the General Service Code as to enable them to at any time place themselves in communication with their commands, or with friendly posts or vessels; but the officers detailed as here described should be designated officially as signal-officers, and it should be a part of their duty for which they are responsible, to see that the signal duties are properly discharged with the commands to which they are attached.

For each Geographical District and for each Division of a Fleet there should be one officer designated as Chief Signal Officer of the District or Division, under whose general supervision shall be the signal duties rendered by the

officers with the different commands, or on the different vessels in the District or Division; these officers to report to superior authority the condition of the equipments and the modes in which the duties are discharged with each command or on each vessel within the district.

For each Army or Fleet, there should be one Chief Signal Officer, who shall have general charge of all matters relating to signal duty, shall see that the proper details are made, and who shall report from time to time on the condition of the service, and upon the efficiency of the officers and men detailed.

It should be required of each District and Division Commander, that in all inspections for reports the drill in signal duty should be examined and reported on precisely as with any other drill practised.

To insure the skill on which on any day the successful management of a command or of a ship may depend, it is suggested that commanding officers order practice-drills as a portion of the officers' regular duty, at certain hours on certain days. When two or more vessels are lying together, the officers are to be required to practise with each other, during these drills, from ship to ship.

Orders from the Commanding Generals and Admirals should establish the use of the General Service Codes throughout their commands; and similar orders should announce, from time to time, changes in the codes of the rules by which they are to be used.

THE END.



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